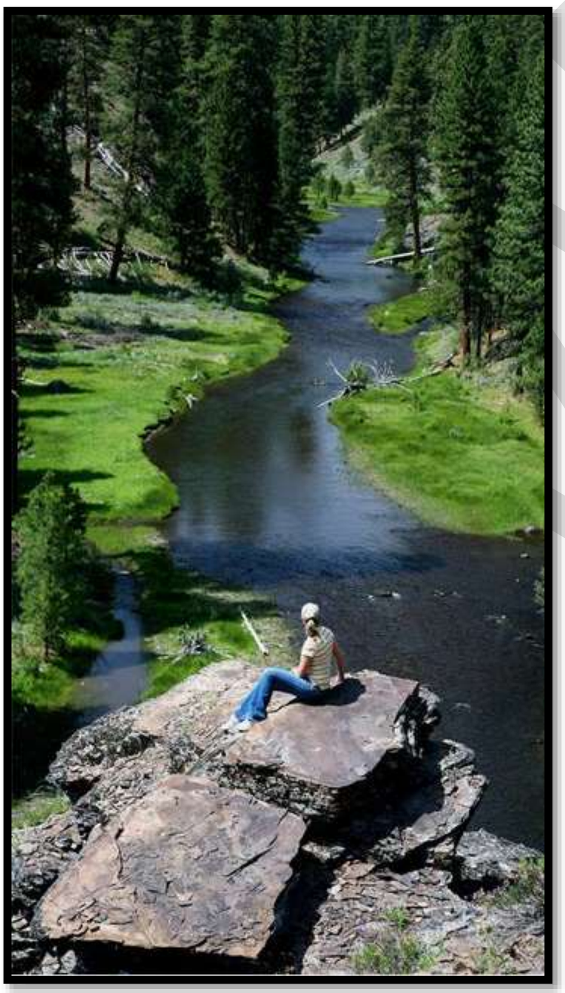
Deliberative Agency Draft -- Not Intended for Comment

Blue Mountains

Aquatic and Riparian Conservation Strategy

Malheur, Wallowa-Whitman and Umatilla National Forests
USDA Forest Service, Pacific Northwest



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1. Introduction

Background and Purpose

This Appendix presents the components of the Blue Mountains Aquatic and Riparian Conservation Strategy (Blues ARCS) that have been incorporated into the revised land management plans for the Malheur, Umatilla, and Wallowa-Whitman national forests. The strategy is based on, and part of, a regional strategy (USDA Forest Service 2008, 2016) designed to protect, maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on National Forest System (NFS) throughout the Pacific Northwest Region.

The regional strategy combines the Aquatic Conservation Strategy (ACS) of the Northwest Forest Plan and elements of PACFISH (USDA-FS and USDI-BLM 1995) and INFISH (USDA 1995) with the intent of providing a common approach to the protection, conservation and restoration of aquatic and riparian-dependent species on all national forest system lands in the Pacific Northwest Region. The ACS, PACFISH and INFISH share the short-term goal of halting habitat degradation and restoring aquatic and riparian habitats. The strategy presented here shares the stated long-term goal of the ACS of developing networks of functioning watersheds that support healthy populations of aquatic and riparian-dependent species.

The Blues ARCS pertains only to the Forests in the Blue Mountains (Umatilla, Wallowa-Whitman and Malheur National Forests, as well as the portion of the Ochoco administrated by the Malheur undergoing plan revision. Like PACFISH and INFISH, the focus of this strategy it to protect, maintain and/or restore the dynamic ecological processes responsible for creating and sustaining aquatic and riparian habitats and provide high-quality water at sub-basin or landscape scales (USDA and USDI 1994a and 1994b). In addition, by means of a Memorandum of Understanding (MOU) between Federal land management (USFS and BLM) and regulatory (NMFS, USFWS, EPA) agencies, this strategy incorporates elements of the Interior Columbia Basin Strategy which are intended to complement other efforts that address natural resource management within the Columbia River basin, including recovery plans for listed species, subbasin planning, TMDL development, and Federal, State, and Tribal habitat restoration efforts.

This strategy is intended to replace PACFISH and INFISH and will represent the long-term aquatic and riparian habitat conservation strategy for the Blue Mountains that will be part of a regionally consistent strategy for the management of aquatic and riparian resources on Federal lands in the Pacific Northwest.

The Blues ARCS retains the eight riparian goals of PACFISH and INFISH and presents them as desired conditions, along with several additional desired conditions that collectively describe the characteristics of productive watershed, riparian, stream channel, and aquatic habitats and the physical and biological processes necessary for their creation and maintenance. The strategy recognizes that watersheds and the riparian and aquatic habitats within them are dynamic systems that vary over time in response to natural and human caused disturbance

(Reeves et al. 1995, Bisson et al. 1997, Beechie and Bolton (1999) and that salmonid species are adapted to spatially and temporally variable habitats implying that habitat variability is important to their long-term survival (Reeves et al. 1999, Waples et al. 2009).

This strategy and the regional strategy that it tiers to are founded in the premise that the existing strategies (PACFISH, INFISH, and ACS) are fundamentally sound, are generally understood by Forest Service personnel, and have significantly improved the management of aquatic resources on NFS lands in the Pacific Northwest (Heller et al. 2004, Reeves 2006). Further, monitoring of aquatic habitats within the areas currently managed under PACFISH and INFISH appear to reflect improving habitat conditions at broad scales, indicating that the strategies have been successful at halting habitat degradation at watershed and larger scales and that at least some elements of riparian and aquatic habitat condition are improving (Archer et al. 2009, Meredith et al. 2012, 2013). Similarly, monitoring of within the area of the Northwest Forest Plan have also shown upward trends in aquatic and riparian habitat conditions (Gallo et al. 2005, Reeves et al. 2006, Miller et al. 2015). Despite these improvements there are still large differences in habitat conditions at managed sites in the Blue Mountains and reference sites located throughout the Columbia River basin (Archer et al. 2009), Reeves et al. (2006) proposed that some improvement may be observed in the short term but full recovery of habitat conditions and the disturbance regimes responsible for their creation and maintenance may take several decades to more than a century to be realized.

An initial summary of PACFISH-INFISH Biological Opinion (PIBO) effectiveness monitoring data using the first year of repeat sampling at 195 sites in the Columbia River basin presented by Archer and Coles-Ritchie (2007) found neutral to favorable (desired direction) changes in seven of twelve habitat variables examined. A comparison of repeat data for the Blue Mountains through 2009 (the 4th year of repeat sampling) using similar methods, found neutral to favorable changes in ten of thirteen habitat variables and 9 of 11 vegetation variables, with 50 to 58 percent of sites showing favorable change, averaged across all sites. Figure 1 depicts the presence and distribution of ESA-listed fish species in the Blue Mountains.

The Blues ARCS includes plan components and other plan content that:

(1) protect and maintain the ecological integrity of terrestrial and aquatic ecosystems and watersheds, riparian areas, and water quality and water resources,
(2) restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds, riparian areas, and water quality and water resources,
(3) contribute to the recovery of Federally-listed species, conserve proposed or candidate species, and maintain viable populations of species of conservation concern, and
(4) identify watershed(s) that are a priority for protection, maintenance or restoration.

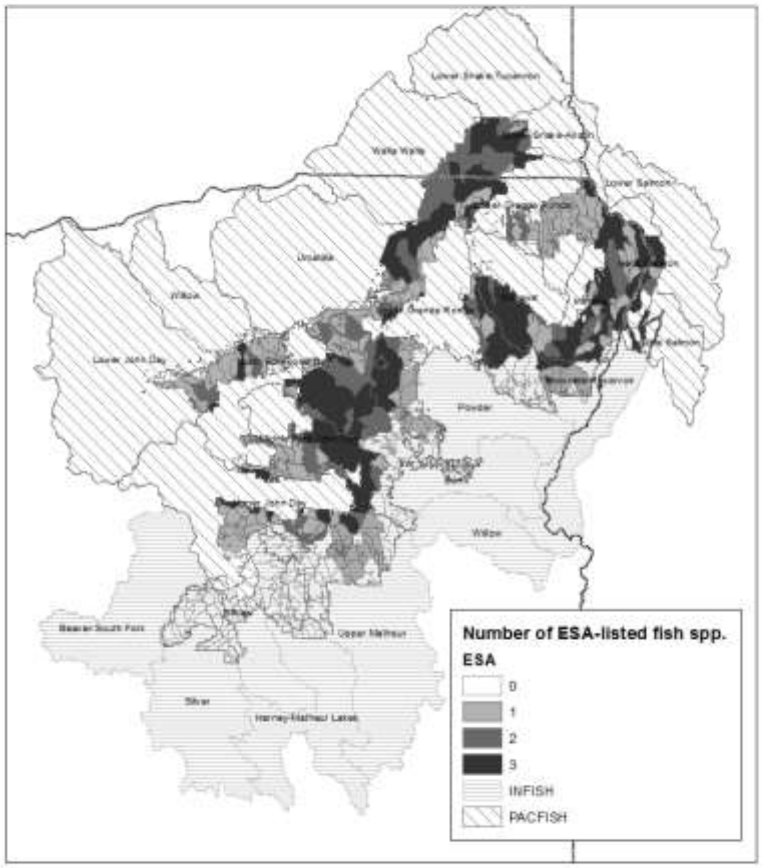

Figure 1. Number of ESA listed species by subwatershed within NFS lands. Cross-hatched areas denote subbasins in which INFISH and PACFISH direction currently applies. Subwatersheds are displayed only within NFS boundaries.

2. Resource Context

NFS lands in the Pacific Northwest Region play a critical role in the provision of water for consumptive (e.g., municipal water supplies) and non-consumptive uses (e.g., instream flows for aquatic ecosystems), both on and off the National Forests. For example, 20-35% of the flow in mainstem Columbia River originates on NFS lands. In comparison, data for the Blue Mountains suggests that roughly 70% of total streamflow in all of the rivers that originate in the Blue Mountains, comes from NFS lands (USDA 2014).

NFS lands in the Pacific Northwest are critically important to aquatic biota, as they contain over 100,000 miles of streams, about 25,000 miles of which are fish-bearing, as well as numerous lakes and wetlands providing some of best remaining aquatic habitats in the region for some species (e.g., Wild Salmon Center 2012). National forests in the Blue Mountains contain roughly 11,000 miles of streams of which roughly half are mapped as fish-bearing streams, including about 3,100 stream miles designated as critical habitat for Federally listed bull trout, steelhead, or chinook salmon.

The quality of water within the national forests is generally high and suitable for most uses (National Research Council 2008). This is largely true of water from NFS lands in the region, but an appreciable number of streams and lakes on these lands do not currently meet State standards for one or more water quality parameters and are thus listed as impaired under the

Clean Water Act (CWA). Within the river basins encompassing the Blue Mountains, 6,800 stream miles in Oregon and Washington, including 1,500 stream miles on NFS lands, do not meet one or more state water quality criteria (WA DOE 2016, OR DEQ 2014).

3. Blues ARCS Overview

Strategy

The Blues ARCS integrates and refines the three existing strategies into a single, unified strategy intended to build upon prior successes, incorporate lessons learned, and address new needs. It combines ecosystem and landscape perspectives to forge a management strategy to be applied over a broad, heterogeneous area. It focuses first and foremost on broad-scale aquatic resource protection, coupled with strategically-focused active restoration in priority areas (USDA Forest Service, 2005).

The Blues ARCS is comprised of five elements: (1) Riparian Management Areas (RMAs), (2) Key Watersheds, (3) watershed analysis, (4) watershed protection and restoration, and (5) monitoring and adaptive management (Figure 2). Each of these is described below in further detail. Interaction of all five elements at the watershed and landscape-scales provides the basis for watershed, aquatic, and riparian ecosystem management and restoration. These components work together and complement each other to achieve the goal of a distribution of watershed conditions that are resilient to disturbance and that protect, maintain, restore, and enhance water quality for multiple beneficial uses and habitat for inland and anadromous fish, other aquatic organisms, and a variety of wildlife and other riparian-dependent resources (FSM 2526) on NFS lands in the region. They will not achieve desired results if implemented alone or in limited combination (FEMAT 1993). As such, they are designed to be applied in an integrated fashion.

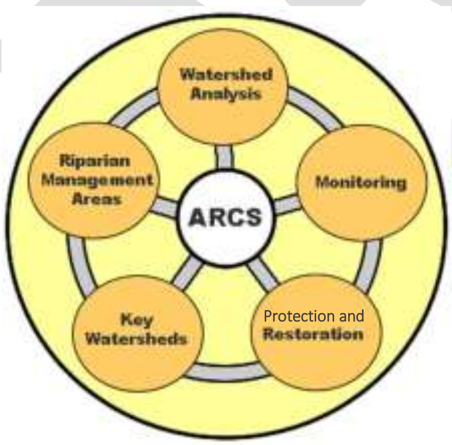

Figure 2. The five primary elements of Blues ARCS. These elements are intended to work together to protect, maintain and restore aquatic and riparian ecosystems and water quality. They are implemented via Forest plan components (e.g., desired conditions, suitability determinations, objectives, and standards and guidelines), other plan content and other administrative direction (see Sections 6-11).

Riparian Management Areas

Riparian Management Areas (RMA) include lands along permanently-flowing streams, ponds, lakes, wetlands, seeps, springs, intermittent and ephemeral streams, and unstable sites that may influence these features. Aquatic and riparian-dependent resources receive primary emphasis in these areas and special management direction applies there. Specifically, management activities in RMAs are designed to protect, maintain, or enhance water quality and the ecological health of aquatic and riparian ecosystems and associated resources. These areas function at the ecosystem level (coarse filter) to represent and maintain the full range of aquatic and riparian ecological diversity. The goal is to maintain a certain percentage and distribution in high quality aquatic and riparian ecological diversity and allow a certain percentage and distribution to persist at lower quality aquatic and riparian ecological diversity.

Key Watersheds

Key Watersheds are a network of watersheds that are important to rare species and/or serve as critical sources of high-quality water for those species and/or municipalities. Special management direction applies to these watersheds. They are selected because of their extraordinary resource values. They may serve as strongholds for important aquatic resources or have the potential to do so. They may be areas crucial to Threatened or Endangered fish and other aquatic and riparian species of concern and/or interest. Key Watersheds may also comprise areas that provide high-quality water important for maintenance of downstream aquatic and riparian populations. In addition, they could serve as municipal drinking water sources for communities in the region. Management emphasizes minimizing risk and maximizing protection, restoration or retention of ecological health. Because part of the Key Watershed selection process is based on the habitat requirements of Federally-listed species and species of conservation concern, the network helps address species-level diversity (fine filter) by conserving and/or restoring critical biophysical processes.

Watershed Analysis

Watershed analysis are an interdisciplinary evaluation of important geomorphic and ecological processes operating in specific watersheds. These analyses: (1) evaluates the condition and trend of watersheds, riparian zones and aquatic ecosystems, (2) assesses connectivity of the watershed for terrestrial and aquatic flora and fauna species, (3) identifies and evaluates resource conditions and trends, and (4) provides the context for management. These types of analyses provide a basis for development of watershed-scale management and restoration strategies and are a tool for more specifically defining desired conditions, developing management objectives and strategies, and designing monitoring strategies.

Watershed Protection and Restoration

The Blues ARCS also includes a more formalized and structured process for watershed protection and restoration than the existing strategies. Specifically, as described in Section 10, the Blues ARCS incorporates concepts from the Pacific Northwest Region's Aquatic Restoration Strategy (USDA Forest Service 2005) and adopts the six-step National Watershed Condition Framework (WCF) process for planning and implementing watershed restoration.

The Blues ARCS, for example, more explicitly recognizes broad-scale aquatic resource protection (passive restoration) during all land management activities as an essential foundation for restoration. The foundation of the passive restoration direction in the plan stems from a suite of robust standards and guidelines which form the basis for design criteria that mitigate the effects to sensitive resources, such as wetlands and riparian areas. Active restoration builds upon this foundation, through targeted, strategically-focused active restoration implemented via the WCF process of watershed assessment, selection of Potential WCF and WCF Priority Watersheds, and development, implementation and monitoring of multi-year, watershed-scale restoration plans (Sections 6 and 10). Priority Watersheds identified through the WCF process are expected to generally be a subset of the broader Key Watershed network. As such, the Blues ARCS incorporates WCF as a near-term (5-7 years) implementation process for restoration across the broader, long-term Key Watershed network. The Blues ARCS also looks to the future by providing a subset of Key Watersheds that may be selected as a WCF Priority Watershed in the future. Through this process, Forest plans will be better aligned with the ESA and CWA, as selection of WCF Priority Watersheds and identification of needed restoration work will be informed by ESA-recovery plans and water quality restoration plans for impaired waters.

Under this strategy, Forest plans for the Malheur, Umatilla, and Wallowa-Whitman national forests include quantitative, measureable objectives for restoration. Objectives describe the general scope and scale of various restoration treatments (e.g., miles of streams restored, miles of road improved or decommissioned) expected to be implemented during the life of the plan and ultimately, the number of watersheds in which all essential restoration actions are expected to be completed.

Standards and Guidelines

Overall, the Blues ARCS standards and guidelines are quite similar to those in PACFISH and INFISH, although, there are some differences (Attachment A). Many of those differences result from the process of integrating and synthesizing direction from three strategies into one. In addition, consistent with recent direction for standards and guidelines (USDA Forest Service 2015), those standards and guidelines associated with procedural requirements (e.g., watershed analysis, interagency coordination) were omitted as plan components in the Blues ARCS, as were standards or guidelines that were already addressed by comparable ones.

In addition to these changes, the Blues ARCS includes some new or substantially modified standards and guidelines (Section 8). Revised standards RF-7, RF-8 and RF-9 help implement direction to incorporate climate change into decision-making, especially that pertaining to infrastructure (e.g., USDA Forest Service 2015, Executive Order-11988). These new road standards provide alignment with new requirements under ESA, while standard KW-1 align with new desired conditions by accelerating progress in addressing road impacts in Key Watersheds. GM-3G was developed to: better incorporate new knowledge regarding relationships between livestock annual use indicators and long-term stream conditions; to address emerging information about the synergistic negative effects of grazing and roads (Al-Chokhachy et al. 2010) and grazing and climate change (Nusslé et al. 2015) on aquatic ecosystems; and to better align with recovery and implementation plans for ESA-listed species (e.g., USFWS 2015a, 2015b, and 2015c) and restoration plans for water quality (e.g., ODEQ 2010, USDA Forest Service 2014). Revised standard FM-2 helps to better manage invasive species risks associated with water use in firefighting and standards FM-1 through

FM-12 provide consistency with recent national policy associated with fire retardant application. The updated guideline RMA-4 places additional emphasize on reducing risks associated with invasive species during water drafting.

MONITORING AND ADAPTIVE MANAGEMENT

The Blues ARCS includes a more consistent, explicit, and structured approach to monitoring and adaptive management than the existing strategies did when they were originally developed. Per the 2012 Planning Rule, it includes both broad-scale and Forest plan level monitoring. Specific elements are focused on determining whether restoration objectives are being attained, whether water quality BMPs and other standards and guidelines are being implemented and are effective at the site-scale, determining the status and trend of watershed conditions and aquatic ecosystems, assessing changes in the distribution of ESA-listed aquatic species and species of conservation concern, and tracking the status and trend of stream temperatures (Section 10).

Importantly, the Blues ARCS defines the types of management decisions that will be informed by monitoring information at various spatial and administrative scales. Linkages between monitoring and other components of the Blues ARCS (e.g., watershed analysis) are also clearly defined.

Expectations and Limitations

The Blues ARCS is intended to prevent degradation of aquatic and riparian ecosystems and to restore the ecological processes responsible for creating those ecosystems and providing high-quality water over broad landscapes (USDA and USDI 1994b). However, it is built upon the knowledge that watersheds and the aquatic habitat that they contain are dynamic systems and that conditions are variable over time (Reeves 2006, Benda et al. 1998). Processes that control the routing and distribution of water, wood, sediment and nutrients shape aquatic and riparian habitats (Naiman et al. 1992) and result in a distribution of aquatic system states shaped by natural and human-caused disturbance (Benda et al. 1998).

It has been proposed that a complete or near complete range of aquatic habitats can be maintained if anthropogenic disturbance are compatible with the natural disturbance regime to the extent possible and further that when natural disturbances do occur that the transfers of organic (wood) and inorganic (sediment) materials to streams are not impeded (Bisson et al. 1997). The occurrence of natural disturbance (fire, floods, debris flows) implies that habitat conditions vary at any given scale so that it is not expected that all watersheds will be in good condition at all times or necessarily that all habitats within a given watershed will be in good condition at all times. However, comparison of habitat conditions in the Blue Mountains to reference conditions suggests the need for improved aquatic habitat conditions at broad scales.

Implementation of the Blue ARCS is expected to substantially contribute to the recovery of ESA-listed fish, including anadromous salmon and trout, by increasing the quantity and quality of freshwater habitat (FEMAT 1993). It is also expected to significantly contribute towards attainment of CWA goals of protecting and restoring the quality of the nation's waters. By itself, however, it is not expected to prevent the listing of species or distinct population segments or enable their full recovery, primarily because factors off National Forest System land often strongly influence populations, particularly those that are migratory. For Federally-listed migratory fish, factors outside the responsibility of Federal land managers contribute to the status and trends of populations. These include the condition of freshwater and estuarine habitats, harvest in commercial and recreational fisheries, management of main stem dams, and the effects of hatchery practices and introductions (National Research Council 1996). Similar limitations apply to water quality. Climate change is another factor beyond the direct control of Federal land managers. Nonetheless, those managers have a responsibility to address and respond to climate change through adaptation and mitigation. Key adaptation actions relevant to water and aquatic resources are reflected in Blues ARCS.

4. Scientific Basis

This section summarizes the science upon which the Blues ARCS is based.

Aquatic and Riparian Ecosystems

Aquatic and riparian ecosystems are highly dynamic in space and time (Reeves et al. 1995). Ecologically healthy watersheds are maintained by natural disturbances that create spatial heterogeneity and temporal variability in the physical components of the system (Naiman et al. 1992a, Bisson et al. 1997, Miller et al. 2003, Rieman et al. 2015). Natural disturbances have resulted in a mosaic of habitat conditions over time and native fish populations have adapted to this dynamic environment (Naiman et al. 1995, Reeves et al. 1995). Aquatic and riparian ecosystems are resilient to the types of disturbances under which they have developed. Recovery from disturbance may take decades or longer, depending upon its magnitude and extent, but some improvements can be expected in 10 to 20 years (Reeves 2006).

Naiman et al. (1992b) described different disturbance regimes based on the frequency and magnitude of disturbance and its location in a watershed (e.g., headwaters, middle, or lower reaches). Under natural disturbance regimes, a landscape would have watersheds exhibiting a range of conditions because of the asynchronous nature of large and infrequent disturbance events (Miller et al. 2003). Other studies describe stream systems as complex, branching networks rather than linear systems, providing a better understanding of the ecological processes that link riparian, aquatic, headwater and downstream ecosystems (Fisher 1997, Benda et al. 2004). These perspectives imply that aquatic ecosystems are not in a steady state. Rather, streams are invariably dynamic, and conditions vary in space and time because of periodic events such as wildfire, large storms and subsequent floods, hillslope failures, landslides, debris flows, and channel migration. An important implication is that streams and aquatic ecosystems are linked to the dynamics of both the riparian and upland communities and the watershed and physical processes that shape them.

Small streams[1] serve as critical source areas for high-quality water. Because the spatial extent of headwater streams comprise a major portion of the total catchment area (Sidle et al. 2000, Meyer and Wallace 2001), these and adjacent upland ecosystems are important sources of sediment, water, nutrients, energy, and organic matter for downstream systems (Furniss et al. 2005, Gomi et al. 2002, Meyer et al. 2003, Wipfli et al. 2007). These relationships are illustrated in Figure 3.

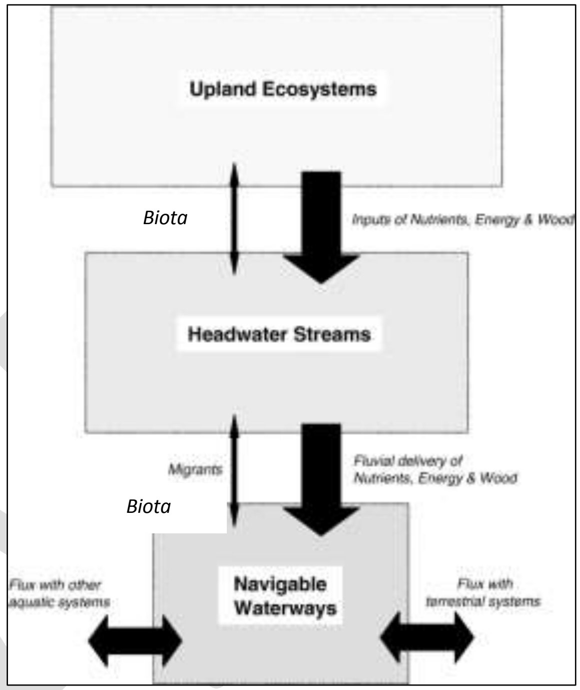

Figure 3. Natural connectivity model between uplands, headwater streams and larger streams and rivers. Headwater streams are sources of energy and serve as conduits for fish, amphibians and other biota, nutrients, energy, and wood, linking upland ecosystems with larger navigable waters downstream (modified from Wipfli et al. 2007).

Riparian ecosystems are among the most diverse, dynamic and complex biophysical habitats on the landscape. They have many interfaces, edges, or ecotones and possess a relatively high diversity of resources. Riparian zones control energy and material flux, are sites of biological and physical interaction at the terrestrial/aquatic interface, support unique vegetation assemblages, provide critical habitats for rare species, and are refuges and source areas for a wide variety of species (Kaufman et al. 2001). Riparian zones also play a critical role in connectivity of watersheds by providing dispersal and travel habitat and corridors across the landscape for both terrestrial and riparian-dependent species. The functions of living and dead vegetation in riparian zones include regulating bank erosion, providing an adequate and continuous supply of coarse woody debris to streams, and providing shade and microclimate protection. Most vertebrates (e.g., 53% of wildlife species occurring in OR and WA) use riparian zones for at least part of their activities (Kaufman et al. 2001). Moreover, approximately 25-30% of plants in Oregon and Washington, respectively, are facultative or obligate wetland species (USDA Natural Resource Conservation Service 2006, FEMAT 1993). These species play a critical role in the productivity, resiliency, and function of riparian zones.

[1] Small streams are also called headwater, intermittent, ephemeral, seasonal, low-order, and upper network streams (after Furniss et al. 2005).

Ecosystem Disturbance, Sensitivity, and Resilience

The Blues ARCS is intended to contribute to the sustainability of aquatic and riparian ecosystems and species. The basic approach is to maintain and restore the ecological health of watersheds and to retain the ability of riparian and aquatic ecosystems to recover from natural disturbances. This approach stems from recent science suggesting that, to provide for resilient, productive, and persistent natural systems, it is important for management to: 1) conserve natural processes that constrain or influence the structure and variability in landscapes, 2) conserve natural variation or diversity, and 3) account for the influence of scale by identifying and conserving patterns and key processes at multiple spatial and temporal scales (Rieman et al. 2006, Rieman et al. 2015).

Stream habitats are heterogeneous and dynamic in longitudinal (headwaters to larger rivers), lateral (stream, floodplain, riparian area interactions), and vertical (stream channel-hyporheic interactions) dimensions (Stanford and Ward 1992). Stream and riparian habitats also vary in their response to disturbance (Reeves et al. 1995). Different physical processes may affect aquatic habitat at different spatial and temporal scales. Figure 4 displays the relative frequencies and scales of selected disturbances that may affect stream channels and watersheds, producing spatially and temporally variable habitats and water quality (Montgomery and Buffington 1998). Disturbance from storms, debris flows and/or fires, for example, are typically more frequent and occur at smaller spatial scales than climate change and tectonic processes. The probability that a particular location will be affected by disturbance at a particular time may be low, but it increases with increasing spatial scale.

The scale of biological response to disturbance will vary depending upon spatial requirements (e.g., home range, territory size, migratory patterns) and temporal constraints (e.g., generation time, migration time) of different species (Rieman et al. 2006). Similarly, the relationship between recovery time and the relative sensitivity to disturbance will vary depending on the relative scale of various habitat and stream features (Figure 5). For example, individual sites have a relatively high sensitivity to disturbance, but relatively short recovery periods. Conversely, watersheds with relatively low sensitivities to disturbance may have relatively long recovery periods (Frissell et al. 1986, Naiman 1998, Naiman et al. 1992b.). Aquatic and riparian ecosystem management needs to account for these processes interacting at multiple scales to establish the context for aquatic resource conservation (Fausch et al. 2002).

Allen and Hoekstra (1992) suggest that to understand ecological processes, it is necessary to assess three scales of ecosystem organization concurrently: (1) the scale in question, (2) the scale below that provides mechanisms (dominant processes), and (3) the scale above that gives broader context, role, or relative significance. The relationship between the finest spatial or temporal resolution studied or of interest (grain) and the size of the study area or study duration (extent) determines the scale of processes that can be understood (Wiens 1989).

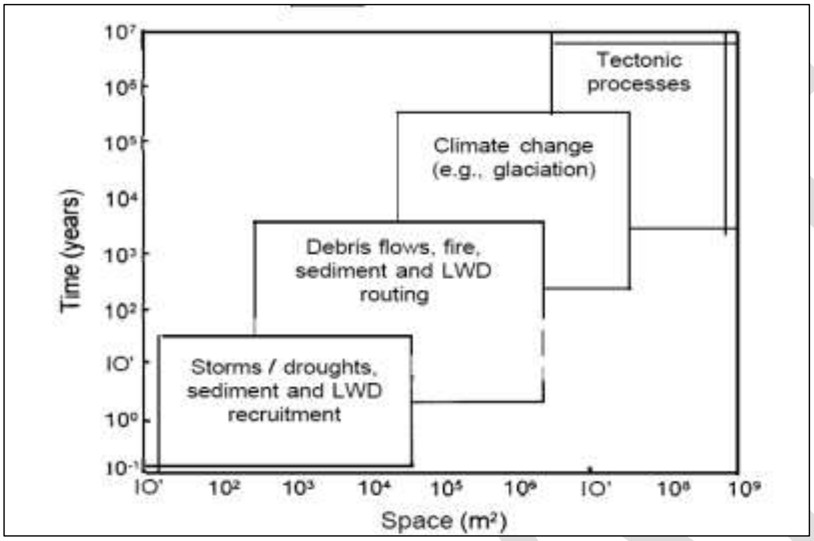

Figure 4. Influences on stream channels at a range of spatial and temporal scales (Montgomery and Buffington, 1998).

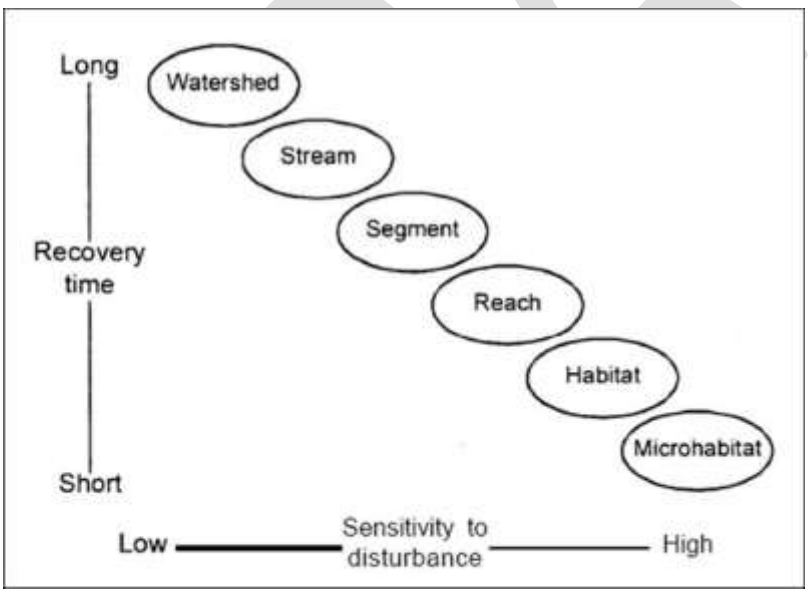

Figure 5. Relationship between sensitivity to and recovery from disturbance at different spatial scales (Frissell et al. 1986, Naiman 1998, Naiman et al. 1992b).

Ecosystem Management

Management and conservation strategies (Holling and Meffe 1996, Dale et al. 2000), including those involving aquatic organisms (National Research Council 1996, Independent Multidisciplinary Scientific Team 1999), require consideration of large spatial and temporal extents and the conservation of biophysical processes rather than just individual biological and physical elements (Rieman et al. 2015). In the case of many Federally-listed fish, this necessitates a continued transition from the current focus on relatively small spatial extents with little or no consideration of temporal dimensions, to larger spatial extents (ecosystems and landscapes) over longer (i.e., 10 – 100 years) periods of time (Reeves et al. 1995, Poff et al. 1997, Naiman and Latterell 2005). Williams et al. (1989), for example, found that at the time, no fish species listed under the ESA was ever recovered after listing. They attributed this failure to the general focus of recovery efforts on habitat attributes, rather than on restoration and conservation of ecosystem processes. The recent delisting of Oregon Chub is a rare success story that stems from its ecosystem management approach.

Factors to be considered in developing ecosystem management plans and policies include the frequency, magnitude, extent, duration (Pickett and White 1985, Hobbs and Huenneke 1992), and context of interacting disturbance regimes (including legacy effects) in managed ecosystems (Hobbs and Huenneke 1992, Reeves et al. 1995, Lindenmayer and Franklin 2002). The resilience of an ecosystem can be reduced if any of these factors are modified. Reduced resilience to disturbance can lead to a decrease in the range of conditions that an ecosystem can experience, extirpation of some species, increases in species favored by available habitats, and an invasion of exotic species (Lugo et al. 1999, Levin 1974, Harrison and Quinn 1989, Hansen and Urban 1992). The effects of land management on the ecosystem depend on how closely the management disturbance regime resembles the natural disturbance regime with regard to these factors.

The focus of the Blues ARCS on ecological processes and dynamics is well supported in the scientific literature. Ecosystems constantly change through time, they are not in a steady state; periodic disturbance is necessary to maintain the long-term productivity and integrity of an ecosystem (Lugo et al. 1999). Based on recognition of ecosystem dynamics, a key focus of ecosystem management and the Blues ARCS is maintaining or restoring ecological processes and resilience as opposed to attempting to maintain a desired set of static conditions through time (Dale et al. 2000). Ecosystem management also strives to maintain a variety of ecological states or patches in a desired spatial and temporal distribution (Gosz et al. 1999, Concannon et al. 1999).

Ehrenfeld (1992) supports these perspectives, noting that conditions in many ecological communities are in flux because of disturbance. This makes it difficult to determine a normal state. Applying fixed standards developed for ecological conditions at small spatial extents with the expectation of achieving constant conditions over large areas is likely to compromise or decrease the long-term productivity of ecosystems and can create false or unrealistic expectations about the outcomes of policies or regulations (Holling and Meffe 1996, Bisson et al. 1997, Caraher et al. 1999, Dale et al. 2000, Poole et al. 2003).

As such, the Blues ARCS does not include relatively uniform and static quantitative management objectives for stream habitat attributes (e.g., pools per mile), known as Riparian Management Objectives, which were incorporated into the PACFISH and INFISH strategies. Instead, as described in Section 11, the dynamic conditions in populations of streams in managed and reference watersheds will be used to track trends at the broad-scale and Forest scale. Moreover, those data along with other information can be used in watershed analysis as a diagnostic tool for assessing conditions in particular watersheds and their causes. Lastly, it can be used to establish more specific desired conditions for individual watersheds (Section 9). Focus will instead be placed on the Matrix of Diagnostics (Anadromous Listed-Fish) and the Matrix of Pathways and Indicators (Bulltrout) used in consultation with the Services. These matrices will be used in conjunction with Standards and Guidelines (e.g., WM-1S and RMA-1S, GM-3G) framed around the watershed conditions that measure '*Functioning Appropriately* (bull trout) /*Properly Functioning* (steelhead/Chinook)', '*Functioning at Risk* (bull trout)/*At Risk* (steelhead/Chinook)' and '*Functioning at Unacceptable Risk* (bull trout)/*Not Properly Functioning* (steelhead/Chinook)' for a variety of metrics. These metrics in combination present a diagnostic tool that will be useful at the project-level to determine whether projects are moving toward or away from functional watershed conditions. Additionally, there is an adaptive strategy that will be useful as a mechanism for changing these metrics as the best available science changes over time or where watershed conditions merit a closer look because they do not fall within the ranges specified.

A variety of sources, including interested citizens, interest groups, scientific review and evaluation groups (e.g., the Independent Multidisciplinary Scientific Team 1999, National Research Council 1996), regulatory agencies, and policy- and decision-makers have called for development of policies and practices to manage the freshwater habitats of at-risk fish at ecosystem and landscape extents. In response, the Blues ARCS focuses on larger, varied spatial scales, longer timeframes and use of "coarse" and "fine" filter strategies to maintain and restore aquatic habitat diversity over a range of spatial and temporal scales. The overarching goal of the ARCS is to prevent degradation of riparian and aquatic ecosystems, restore habitat and the ecological processes responsible for creating habitat over broad landscapes (USDA and USDI 1994b). To ensure that management activities help to move watersheds, riparian and aquatic habitats toward desired conditions across the planning area at multiple spatial scales (Franklin and Lindenmayer 2009), the ARCS includes Forest Plan components (i.e., desired conditions, suitable use determinations, standards and guidelines, and monitoring) that apply to RMAs wherever they occur. Other applicable plan components include active watershed restoration and monitoring (USDA 2008), along with strategic elements which are not plan components (e.g. watershed assessments and designation of key watersheds). Success in meeting desired conditions requires full application of all these elements (USDA 2008).

The coarse-scale strategy assumes natural disturbances will create and maintain a shifting mosaic of aquatic habitats across the landscape, capable of supporting native aquatic species diversity through time (Haufler et al 1996, Wallington et al 2005). Assuming the ARCS is effective, the proportion of watersheds in good condition is expected to remain the same or increase over time (Reeves et al. 2006); not all watersheds will be in good condition at any point in time, nor will any particular watershed be in a certain condition through time.

The fine-scale strategy refines an earlier coarse-scale concept of a static network of conservation reserves (Nature Conservancy 1982, Frissell and Bayles 1996), by creating a network of "key" watersheds based on strong local populations and high-quality habitats for a suite of vulnerable "surrogate" species that may not be sufficiently protected by the disturbance-based coarse-filter strategy alone (Noss 1987, Hunter 1991). These species inhabit a range of aquatic environments in the planning area. We assume that the surrogate species and their habitats represent the temporal and spatial variability in habitats needed by other species, and will be sensitive to habitat changes likely to occur. Key watersheds also include readily restorable watersheds for active restoration with the goal of improving connectivity between current strong populations and high-quality habitats, and providing future high-quality areas through time as current high-quality habitats are altered by natural disturbance processes. Select standards and guidelines provide additional fine-scale plan protections for key watersheds and critical habitats for federally-listed surrogate species. In the short term (10-20 years) full implementation of the fine-scale strategy is intended to protect watersheds that currently have good habitat and fish populations (FEMAT 1993; USDA-R6 ARCS, 2008).

Spatial Scales for Watershed and Aquatic Ecosystem Management

Effective watershed and aquatic ecosystem management requires analysis, planning and action across a range of spatial scales. The National Watershed Boundary Dataset (http://nhd.usgs.gov/wbd.html) provides a consistent basis for this. The spatial scales most relevant to the Blues ARCS are: river basin (6-digit hydrologic unit code, HUC or 3^{rd} field HUC), subbasin (8-digit HUC or 4^{th} field HUC), watershed (10-digit HUC or 5^{th} field HUC), subwatershed (12-digit HUC or 6^{th} field HUC), drainage, and site (Figure 6). These terms are used throughout this document.

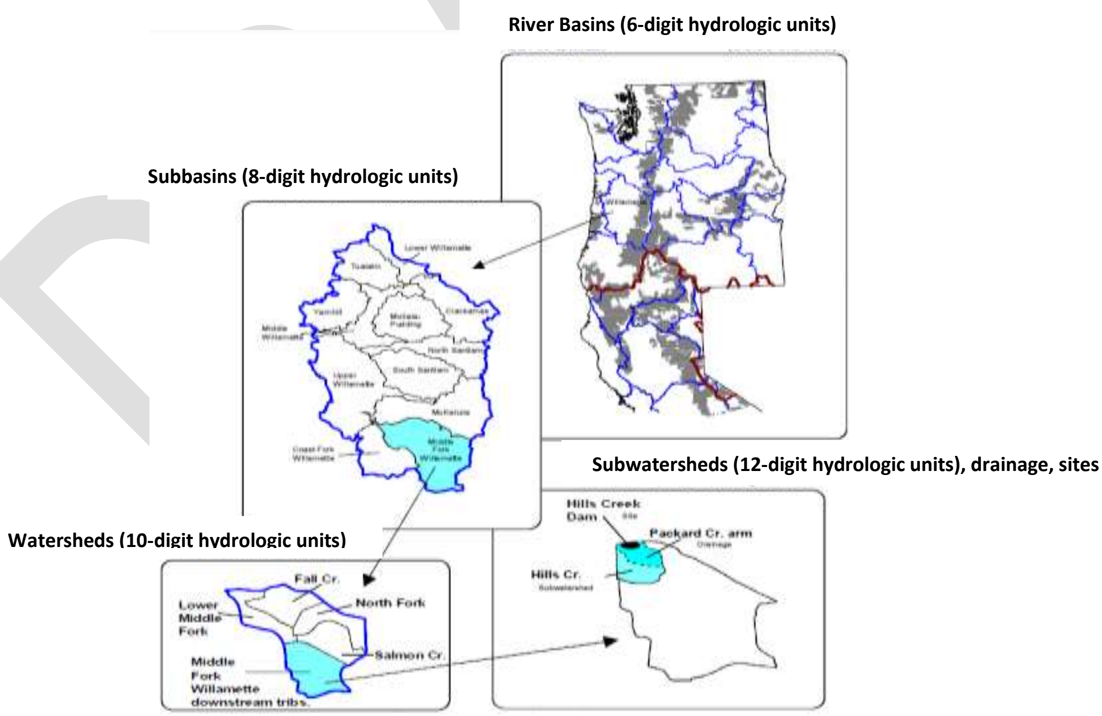

Figure 6. A hierarchy of spatial scales and terms for managing watersheds and aquatic and riparian resources.

Aquatic populations have been classified in a manner consistent with the watershed-scale definitions. Bull trout core populations (Whitsell et al. 2004) and anadromous fish populations, for example, have been generally identified at subbasin scales. In addition, Bull trout local populations and anadromous fish major and minor spawning areas are generally defined by watersheds or subwatersheds.

Riparian Management Area (RMA)

Protection and restoration of riparian areas is particularly important to achieving the Blues ARCS goals and objectives. Riparian management strategies differ substantially across the United States and within the Pacific Coastal region (Lee et al. 2004, Everest and Reeves 2007). Key differences include the type and size of riparian areas identified for protection or restoration (e.g., RMA widths), management goals for them (e.g., desired conditions), the kinds and timing of activities that are or are not permissible (e.g., suitability), and the nature of management direction used to guide or constrain those activities (e.g., standards and guidelines).

The Blues ARCS approach to riparian area management involves designation of relatively large default RMAs to protect and restore water quality, habitat for a wide range of aquatic and terrestrial species, and critical ecological processes (Section 6). Watershed analysis can be used to adjust these default RMA widths in particular watersheds (Section 9). The scientific basis for this approach was originally provided in FEMAT (1993) and later supported by a review by Everest and Reeves (2007), who concluded that there was no scientific evidence that either the default prescriptions or the options for watershed analysis in the NWFP provide more protection than necessary to meet stated riparian management goals.

RMAs are not intended as exclusion zones or reserves. Instead, management activities designed to benefit aquatic and riparian-dependent resources and move the landscape towards desired conditions are allowed and encouraged within them. Furthermore, while the Blues ARCS default RMA widths are uniform, the management of them is not intended to be. Instead, a wide range of management activities, involving highly-varied prescriptions, are expected to occur within them. These activities are to be planned and implemented based on watershed that lead to project-specific designs that prescribe the types, locations, spatial extent, and timing of the activities. These designs must meet applicable standards and guidelines. This approach recognizes that effective project designs, including identification of both treated and untreated areas, depends on objectives and on local landscape context (Richardson et al. 2012).

Evolving science continues to provide new insights to help inform project-level plans for activities in RMAs. Recent scientific syntheses related to ESA-consultation in western OR (USDA Forest Service et al. 2013), for example, provide information about the potential effects of forest thinning on stream temperature, large woody debris, and terrestrial wildlife species. Other recent work (e.g., Benda et al. 2015, Olson et al. 2014, and Olson and Burton 2014) provide additional science that can be used to plan and implement management activities in RMAs to help achieve desired conditions.

The management approach adopted in the Blues ARCS differs substantially from other strategies that often have different management goals, specify smaller riparian areas, and/or contain more prescriptive and uniform regulatory standards across broad, diverse areas. It is consistent, however, with recent trends away from simple, uniform standards, towards more complex guidelines that are planned and implemented at larger, watershed scales (Lee et al. 2004).

New Threats

Two threats, climate change and invasive species, have emerged as major issues since the existing strategies were first developed in the early to mid-1990s. These threats and the ways in which the Blues ARCS addresses them are described in the following section. Importantly, these risks and uncertainties do not suggest a need to change the basic structure and components of the Blues ARCS. Instead, they reinforce and amplify the need for this type of strategy, the associated monitoring and adaptive management (Seavey et al. 2009, Furniss et al. 2010). As described below, these threats will also influence the details of how the Blues ARCS is implemented at subbasin, watershed, and site scales (Furniss et al. 2010, Rieman and Isaak 2010, Perry et al. 2015).

Climate Change

Science conducted since the existing strategies were developed has greatly advanced understanding of the potential effects of climate change on water resources and aquatic ecosystems. Some of this knowledge was summarized by the Independent Scientific Advisory Board (ISAB), which provides independent scientific advice and recommendations to the National Marine Fisheries Service, Columbia River Indian Tribes, and Northwest Power and Conservation Council in 2007 (ISAB 2007).

The ISAB identified the following potential impacts in the Pacific coastal region future: (1) higher temperatures will result in more precipitation falling as rain rather than snow; (2) snowpacks will diminish and seasonal stream flow patterns will be altered; (3) peak river flows will likely increase; (4) summer low flows will be lower; and (5) water temperatures will continue to rise. The magnitude of likely effects and the sensitivity of affected resources varies substantially across the landscape and not all anticipated effects are necessarily harmful to aquatic habitats. In addition, the magnitude of anthropogenic impacts may be much greater than climate impacts. Nonetheless, climate change will likely have major implications for native fishes and aquatic ecosystems.

Climate change is expected to increase large flood events, wildfires, and forest pathogen outbreaks. These could actually improve habitat complexity in some areas as a result of floodplain reconnection and large wood recruitment. However, many climate change effects will likely have negative habitat consequences for aquatic organisms. For example, more frequent severe floods may increase egg mortality due to gravel scour. These effects, however, are unlikely to extirpate entire populations of salmonids because while scour magnitude may increase, the frequency of these events relative to typical salmonid life cycles is relatively low (Goode et al. 2013). Moreover, unconfined portions of the stream network are less susceptible to increased scour than those in confined valleys because overbank flows can spread across floodplains.

Winter snowpacks will likely retreat and runoff earlier in the spring (Mote et al. 2003a and 2003b), potentially impacting species whose migration to the ocean is timed to coincide with plankton blooms (Pearcy 1997). Summer base flows will probably decline. This may shrink the network of perennially flowing streams and thus force fish into smaller channels and less diverse habitats (Battin et al. 2006). Warmer water temperatures would increase physiological stresses and lower growth rates. Summer peak temperatures may approach or exceed lethal levels for salmon and trout (Crozier and Zabel 2006, Crozier et al. 2008). Higher temperatures will also favor species that are better adapted to warmer water, including potential predators and competitors (Reeves et al. 1987). Recent science, however, suggests that stream temperatures in steep, mountain streams of the Pacific Northwest may be less sensitive than those in larger, low gradient rivers (Isaak et al. 2016).

Climate change will likely force shifts in the distribution of fish populations. This could reduce their resilience to natural disturbances, particularly drought (Battin et al. 2006). Streams located high in watersheds that historically provided some of the best habitat may no longer be accessible to migratory fish if snowpack is reduced, thus limiting available rearing areas and access to thermal refugia in summer. Even moderate climate-induced changes may significantly increase the risk of extirpating local populations of Chinook salmon (Crozier et al. 2008). Climate-related factors such as temperature and streamflow could affect habitat in different ways and at different scales, depending on local site characteristics. Therefore a diversity of conditions is needed for population stability (Crozier and Zabel 2006).

Existing well-connected, high-elevation habitats on public lands will be important to supporting salmon survival and recovery as the climate continues to warm (Martin and Glick 2008). Protecting, maintaining and restoring these areas is a fundamental objective of the Blues ARCS. The strategy incorporates numerous adaptive actions relevant to climate change. These include maintaining instream flows by managing water withdrawals, reducing flood peaks by enhancing floodplain connectivity and disconnecting roads from streams, reconnecting isolated habitats by removing anthropogenic barriers, managing riparian forests to provide shade and other functions, and improving waters where aquatic habitats and water quality have been degraded (Furniss et al. 2010). Importantly, some of these actions can, in some situations, more than offset the effects of climate change (Diabat et. al. 2016). Actual impacts to aquatic ecosystems will be highly dependent on the degree to which these adaptation actions are implemented now and in the future. Without them, aquatic habitats may become increasingly isolated, simplified, and less likely to recover after significant disturbance events.

Climate change has been factored into the Forest Plans, in that many of the desired conditions factor climate change into them. The Forest Service has added a monitoring plan component, to insure that monitoring of climate change effects. Lastly, the Blue Mountain Climate Change vulnerability assessment and adaptation strategies (e.g., Halofsky and Peterson, 2016) will be incorporated into the plans. As the assessment, becomes incorporated, findings will be incorporated, by validating the desired conditions, standards and guidelines, Key and Priority Watershed selections, integrating additional objectives indicating our commitment to address vulnerable ecosystems and processes in this plan period, and potentially, additional standards and guidelines. The vulnerability assessment utilized the best available science to assess the impacts of changes in streamflows, stream temperatures, and disturbance regimes on water and aquatic resources. The map-based products summarized in the assessment will form the basis for characterizing the relative magnitude, spatial and temporal variability of these effects across the landscape.

Invasive Species

Climate change effects will be compounded by those associated with the distribution of aquatic and terrestrial invasive species, which are likely to intensify in the future. For example, in some large coastal rivers, non-native species have come to dominate fish assemblages and have largely replaced native fishes within the river food web. The effects of invasive riparian plants on the water quality, nutrient cycling, and the physical habitat of streams and lakes are not fully understood. However, some species have been studied to the degree they raise concern. Japanese knotweed, for example, can displace other riparian vegetation chemically and physically (crowding and shading), but it dies back with the first frost, exposing stream banks to erosive winter stream flow forces until they emerge again in the spring (Urgenson 2009).

The magnitude of these effects will depend on the effectiveness of invasive species prevention and eradication programs, the reinvasion rate of invasive species after control actions are taken, and the speed with which native species reoccupy habitats previously dominated by the non-native species. Effective control will also depend heavily on successful public awareness programs to prevent spread of new invasive species on both public and adjacent private lands. The Forests are committed as part of their management focus to detect, eradicate, control, or contain high priority aquatic invasive species occurrences, where feasible.

The Blues ARCS addresses these issues through specific standards and guidelines focused on preventing or reducing the spread of invasive species. In addition, invasive species will be addressed through watershed protection and restoration, via implementation of WCF and other treatments outside of Priority Watersheds.

5. Key and Priority Watersheds

Definition and Purpose

Key Watersheds are intended as areas that either provide, or are expected to provide, high-quality habitat or water for rare aquatic and riparian species and/or provide high-quality drinking water to communities that depend upon USFS watersheds as their municipal water sources.

For the purpose of selecting Key Watersheds, rare species include Threatened or Endangered fish and wildlife species and Species of Conservation Concern. Therefore Key Watersheds may also be designated based upon the presence of high-quality habitat for these species. Key Watersheds complement the management direction provided by other ARCS elements and plan components because they are identified to support fish and water quality recovery plans, but also because they are selected based on a ranking system that is in turn based on an assessment of watershed conditions, habitat conditions, population status, and restoration potential.

Key Watersheds provide a network of refugia at the ESU (Evolutionary Significant Unit), Recovery Unit, or population scale. A network of Key Watersheds, managed to serve as refugia, is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species (FEMAT 1993). Refugia include areas of high-quality habitat as well as areas of degraded habitat that have high potential to develop into productive habitat. The network is designed to provide species level conservation and restoration of habitat conditions to retain strong/anchor populations of fish species of interest and species of concern in the short term, and contribute to recovery in the long term. In the short term, key watersheds provide centers of fully functioning, high-quality, aquatic and riparian habitat and a starting point for longer term expansion of such habitats. Key Watersheds with high-quality habitat will serve as anchors for the potential, near-term recovery of depressed stocks. The relative contribution to long term conservation and recovery provided by the Key Watershed network will vary depending on species, habitat, life history requirements as well as the quality and extent of habitat existing within NFS lands. Watersheds containing lower quality habitat with high potential for restoration are expected to become future sources of high-quality habitat with the implementation of a comprehensive restoration.

Watersheds that act as sources of high quality water were considered in the selection of key watersheds. Among these are watersheds that are sources of cold water to downstream watersheds and watersheds that are sources of water for domestic use. In the revised forest plans, municipal watersheds are designated as management areas in which the primary emphasis is the protection of water quality for human use and management actions are subject to the terms of the agreements that established each individual municipal watershed. Four cities in the Blue Mountains (Baker City, La Grande, Canyon City, and Walla Walla) have designated municipal watersheds. In addition, several cities (Richland, Long Creek, Sumpter, Joseph, and Pendleton, and Prairie City) have water sources within watersheds on the national forests designated as Public Source watersheds by the State of Oregon, and several more have either surface or groundwater sources on NFS lands as their primary source of drinking water. Protection of all public water supplies is guided by both State and Federal Law under the Safe Drinking Water and Clean Water Acts. While these watersheds generally have good water quality and watershed conditions, they may or may not possess the riparian and aquatic habitat, population criteria, or restoration potential that qualifies them as key watersheds. Table 1 displays municipal and public source watersheds identified in the forest plans and those that have been identified as key watersheds.

Table 1. Municipal and public source watersheds on NFS lands in the Blue Mountains.

City	Watershed	KWS (y/n)	Management
Baker City	Salmon Creek	N	Roadless
La Grande	Beaver Creek	N	Roadless
Canyon City	Byrum Gulch	N	Strawberry Wilderness
Walla Walla	Mill Creek	Y	Roadless
Pendleton	N. Fork Umatilla	Y	N.F. Umatilla Wilderness
Sumpter	McCully Creek	N	Public Source Watershed (OR)
Richland	Eagle Creek	N	Public Source Watershed (OR)
Joseph	Wallowa Lake	Y	Public Source Watershed (OR)
Long Creek	Upper Long Creek	N	Not designated
Prairie City	Dixie Meadows	N	Public Source Watershed (OR)

While Key Watersheds are designed primarily to provide high-quality habitat for aquatic species, other aquatic or riparian and upland species also benefit from the Key Watershed network. Management direction in Key Watersheds is intended to provide the highest relative level of protection and the lowest relative level of risk from activities threatening their integrity and resiliency. The location of Key Watersheds relative to one another is important. Key Watersheds are intended to be positioned so they form the centers of broadly connected networks of high-quality watersheds and restore currently fragmented habitats and core conservation fish populations. However, because Key Watersheds are only identified on NFS lands, the ability to connect adjacent habitats and watersheds is also dependent on the location of ownership boundaries which were largely set at the time the National Forests were established. In some cases, and depending on downstream land and water uses, this may result in limited ability to connect habitats for aquatic species, or that connection is still possible, but habitats downstream of the forests may be in poor condition, and/or have limited restoration potential.

Key Watersheds are complemented by other land conservation and restoration designations, such as Wilderness, Recommended Wilderness Areas, Backcountry Areas, Inventoried Roadless Areas, and Wild and Scenic Rivers, forming a network of areas with a passive management emphasis. Identifying key watersheds adjacent to or surrounding these areas often provides the most favorable opportunities for providing connected networks of high quality and/or restorable habitats. These networks can then provide for the resiliency of aquatic, terrestrial, and riparian-dependent species to the maximum extent practicable within the capability of the national forests.

Research supports managing important watersheds more conservatively in terms of future risk and restoration. Conservation of meta-populations requires numerous patches of suitable habitat over time and the potential for dispersal among patches (Harrison 1994).

Where there is currently an insufficient number of high-quality habitat patches, it is important to protect existing high-quality patches in the near term (Frissell 1997). Minimizing or eliminating external threats increases the likelihood of persistence of high quality patches (Carroll and Meffe 1997). These areas will serve as sources of individuals to colonize new patches as they develop favorable habitat. Development of future patches of favorable habitat requires the protection or restoration of critical ecological processes creating favorable habitat over time (Carroll and Meffe 1997).

Key Watershed Network Identification

For the most part, the process for identifying Key Watersheds follows the methods outlined in Reiss, et al. 2008. The principal difference is that habitat conditions received more consideration in the selection process in the Blue Mountains than is described in Reiss et al. (2008). In the Blue Mountains, Key Watersheds have a combination of relative population strength for one of four aquatic surrogate species (Chinook salmon, steelhead, inland redband trout, and bull trout), good watershed conditions, and good aquatic and riparian habitat condition. Watersheds that represent various environmental gradients were part of the selection criteria, under the assumption that environmental variation is a useful surrogate for ecosystem and species diversity and sustainability. Key watersheds are less likely to be affected by past land uses and more likely to be important to the maintenance of water quality and quantity for a variety of downstream uses, including human uses. Key Watersheds are expected to be managed so that risk to aquatic and riparian habitats is minimized. Key watersheds are identified at the subwatershed level and consist of areas averaging 20,000 in the Blue Mountains.

The four surrogate species selected for analysis in the Blue Mountains were selected in part because information on their status and distribution is available. As a group, these four species occupy habitats that encompass nearly the full extent of aquatic habitats on the three national forests in the Blue Mountains. Steelhead and Chinook salmon are extinct upstream of Hells Canyon Dam and thus are absent from their former range in the Powder, Burnt and Malheur rivers. Remnant populations of resident inland redband trout persist in these basins. Resident redband trout likely also exist within the present range of anadromous steelhead in the John Day, Umatilla, Walla Walla, Tucanannon, Grande Ronde and Imnaha rivers, but to our knowledge there aren't data that would distinguish between anadromous and resident redband populations in these basins. None of the four selected surrogate species occupies the full extent of their former habitat in the Blue Mountains, based on available data.

Aquatic ecological condition within individual sub-watersheds were assessed using a decision support model by analyzing surrogate species status and watershed conditions in combination (Figure 7). Surrogate species status and condition were determined by assessing: 1) Species distribution, 2) population status, 3) connectivity, and 4) the effects of non-native species. Watershed conditions were assessed by a combination of roads and related effects, and the condition of terrestrial and riparian vegetation. Key watersheds are identified that have a combination of strong populations for one or more surrogate species and good habitat conditions. Key watersheds are identified at the sub-watershed scale and in some cases may consist of groups of sub-watersheds. The selection process follows Reiss et al. (2008) with minor modifications.

Model output scores for population status, watershed condition, and aquatic habitat condition were tabulated by subwatershed and combined to arrive at a total subwatershed score, then ranked in descending order. Subwatersheds were ranked by location: 1) for the Blue Mountains, 2) by forest, and 3) by sub-basin.

In watersheds with multiple species, subwatersheds were ranked based on the highest species score, as opposed to combining the scores of multiple species, based on the finding that combining multiple species scores de-emphasized habitat values in the ranking. Using the highest species score tended to level out the relative weights of habitat and population strength. Combining population scores for individual HUCs also tended to favor anadromous species (but in very few HUCs) over watersheds that provided habitat for a single, usually resident, fish species (i.e. inland redband). This adjustment did not eliminate watersheds providing habitat for anadromous fish as key watersheds, but served to extend the key watershed network to watersheds that are known to provide habitat only for resident fish. Key Watersheds with multiple species were considered to have higher priority for restoration.

An initial model run, using forested vegetation departure, road density and surrogate species status was used in the initial selection of Key Watersheds. This method identified roughly two-thirds of the restoration priorities identified by the Malheur, Umatilla and Wallowa-Whitman National Forests (USDA 2005, USDA 2001, USDA 2002).

Subsequent iterations of Key Watershed selection were based on expectations of recovery plan goals, critical habitat designation, and expected partner agency interest in watershed-scale restoration. The first iteration of key watershed selection occurred in late 2008 and several modifications were made to the key watershed network between mid-2009 and March 2010. Restoration priorities were chosen between March and June 2010. Review and modification of the key and priority watersheds has occurred intermittently since 2010 as ongoing restoration work.

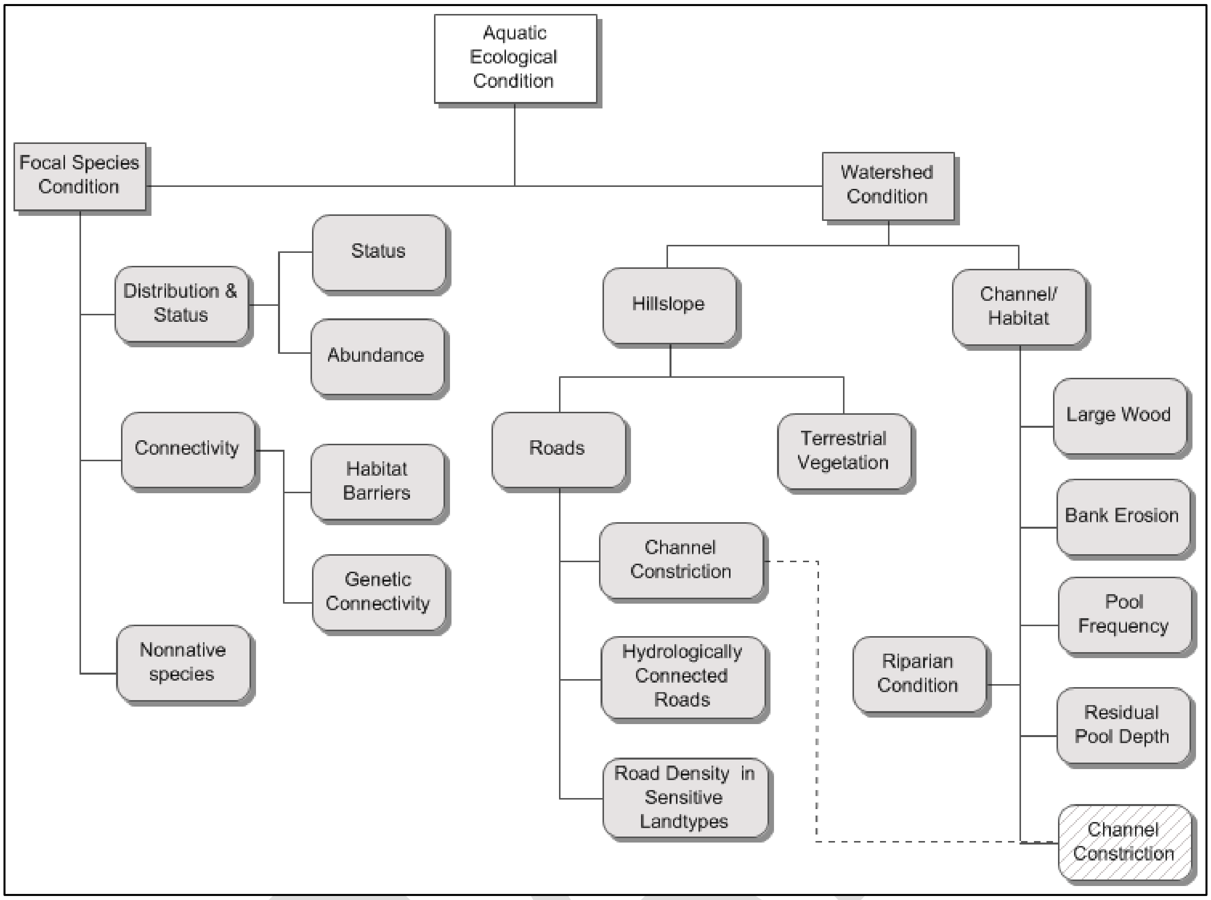

Figure 7. Basic Decision Structure for Determining Aquatic Ecological Condition of Watersheds in the Blue Mountains (modified from Reiss et al. 2008)

Population status by sub-watershed was determined using a set of criteria, developed by the Inland West Watershed Initiative (IWWI) (USFS 1997), which identified strong versus depressed population or metapopulation conditions in the subwatershed. Each stream segment was assigned one of eight categories; depending on the amount of data and information available. These categories were: present strong, not strong but key habitat feature, present depressed, present migration corridor, present unknown status, absent, unknown, and extinct.

“Strong” populations were identified as having all of the following characteristics: (1) stable numbers or are increasing; (2) all major life history forms that historically occurred within the subwatershed are present; (3) the local population is likely to be half or more of its historic size or density; and (4) the local population in the subwatershed or the metapopulation in the larger region of which the local population is a part of is likely to be at least 5000 individuals or 500 adults. The local population is not isolated by distance or natural barriers from other local populations that would collectively exceed these numbers.

“Depressed” conditions were identified as depressed population for native species (defined for use in the Blue Mountains Aquatic Sustainability Model) as having one or more of the following characteristics: (1) one or more life histories formerly present are absent (example migratory or resident form of bull trout); (2) population numbers are declining or less than half of historic numbers or the population occupies less than half of its historic habitat in the subwatershed; or (3) the local population in the subwatershed or the metapopulation in the larger region of which it is a part of is less than 5000 individuals or 500 adults (i.e., the local population is isolated by distance or natural barriers from other populations which would collectively exceed these numbers). If historic information is not available, population densities are less than half of comparable undegraded subwatersheds where the surrogate species is well-distributed. If numbers are strong but the surrogate population is seriously hybridized with non-native species, the pure native population of the surrogate species is considered depressed.

Additional categories identified the presence of “migration corridors”, whether species are considered “extinct”, “absent” or their presence is “unknown”. Subwatersheds that did not have strong populations, but contained one or more key habitat characteristics important to the sustainability of the species (i.e., spawning habitat, cold water refugia, critical habitat) on NFS lands were assigned the “not strong but key habitat feature”. Watersheds identified as having important habitat features are also tagged for use in the habitat portion of the model. In some cases, the identified habitat feature may be the only habitat available to a local population.

Based on available information, only 17 of 550 subwatersheds on the three forests were identified as having strong populations using this definition. The only surrogate species for which strong populations are believed to be present are bull trout. However, it is recognized there may be populations of other surrogate species that occupy areas larger than an individual subwatershed that might be considered “strong” using a different definition. The resulting maps display relative population strength and distribution for each of the four surrogate species, based on a combination of local knowledge and available aquatic inventory data.

Watershed conditions were assessed as a function of the degree of: 1) alteration of terrestrial vegetation from reference conditions, including the resulting change in fire regime; 2) the extent of the road network and the resulting effects on hydrology, erosion and sedimentation, channel constriction; and 3) the status of riparian plant communities.

Watersheds identified as key watersheds within NFS lands, with few exceptions, possess the best remaining habitat and strongest fish populations in the Blue Mountains. One of the most notable exceptions occurs on the Umatilla River and results from efforts by the Confederated Tribes of the Umatilla Indian Reservation to restore habitat conditions for anadromous fish species and the reintroduction of Coho salmon.

Watersheds with the highest potential for restoration were identified and ranked within each sub-basin and on each forest. These are watersheds having the highest potential to connect existing high-quality habitats or replace existing habitats as conditions change over time. They are generally located adjacent to or downstream from the watersheds identified above and serve to extend or connect existing high-quality habitats.

Watersheds were also identified in which watershed restoration is ongoing or being planned and where a substantial part of the work will be off-forest or where planned restoration is expected to be conducted by an agency or partner other than the Forest Service. A few watersheds in which active partnerships and investment in restoration has or will occur have not been identified as Key Watersheds, but still recognize the interests of active partners in watershed and habitat restoration. In these watersheds, restoration actions on NFS lands will complement restoration activities outside of NFS lands. In several cases, these watersheds are, or will be, the highest priorities for restoration on the national forests.

Priority Watersheds for Restoration

Using the process described above 209 subwatersheds are named as key watersheds, of which 70 are considered priorities for restoration (Figure 9). Priority watersheds identified here, are either sites where watershed and habitat restoration is ongoing, where restoration work is planned, but has not yet commenced, or is expected to occur in the next 10-15 years.

In 2011, the Watershed Condition Framework, or WCF (USDA FS 2011), was instituted to provide a nationally consistent approach to 1) assess watershed conditions, 2) prioritize watersheds for restoration, 3) develop restoration plans, 4) implement needed restoration, 5) track restoration accomplishments, and 6) monitor and verify the effectiveness completed restoration (Figure 8).

Under this approach, each forest is expected to select two to three sub-watersheds for restoration that can be completed in the next five years. The process is repeated at five year intervals, resulting in a new set of priorities for restoration and the completion of restoration work following the 6 steps described above. The intent of the process is to accelerate the pace of needed watershed restoration while improving communications with partner agencies and providing a mechanism for tracking implementation and the effectiveness of completed work.

Definition and Purpose of Watershed Condition Framework Priority Watersheds

The number of WCF Priority Watersheds will vary by national forest but is expected to range from one to five, given current funding levels. The framework, which includes identification of WCF Priority Watersheds, is summarized in Figure 8 and described in detail in Section 10. WCF Priority Watersheds are the 12-digit hydrologic units (subwatersheds or HUC 12) in which near-term (e.g., 5-7 years) restoration programs and resources will be focused. Selection of these subwatersheds will be based on several criteria, as described in the following sections. WCF Priority Watersheds will generally be a subset of the broader, longer-term Key Watershed network and associated Potential WCF Priority Watersheds.

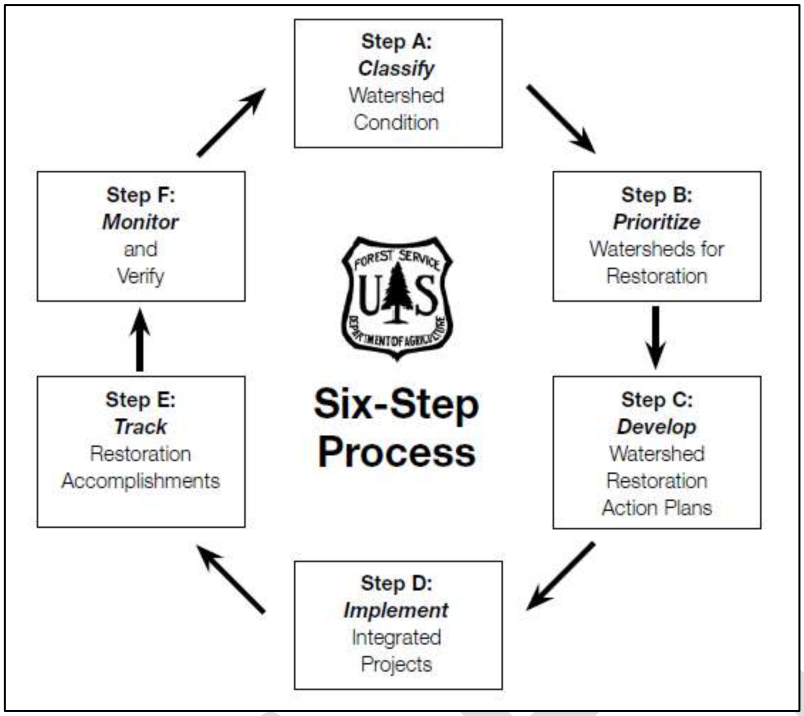

Figure 8. Watershed Condition Framework, a 6-step process for watershed restoration.

Designating Watershed Condition Framework Priority Watersheds

The responsible official will continue to select WCF Priority Watersheds based on an interdisciplinary analysis and evaluation. In addition, the responsible official will reach out to local, State, Tribal, other Federal agencies, and interest groups when identifying WCF Priority Watersheds (FSH 1909.12, Chapter 20, Section 22.31).

Criteria for selection include:

- the value of the watershed from a water/aquatic resource perspective;
- existing watershed, water quality, and aquatic habitat conditions;
- Key Watershed status;
- alignment with other strategic objectives or priorities at National, Regional, or local levels;
- alignment with priorities of other agencies and potential partners;
- estimated costs and unit work capacity; and
- technical, financial, and social opportunities and constraints.

Priorities will generally focus on those watersheds that are in good to fair condition, but still require some restoration. This approach, consistent with principals of conservation biology (FEMAT 1993, Roni et al. 2002), will enable watersheds to be restored with reasonable investments of time and funding. As with Key Watersheds, the potential effects of climate change and the efficacy of restoration treatments in ameliorating those and other effects (e.g., land use) should be considered in the selection of WCF Priority Watersheds and subsequent identification of the scope and scale of needed restoration work.

Priority Watersheds

The present set of Key and Priority Watersheds are displayed by forest in Attachment A, Table 2 through Table 4. Watershed boundaries, unit codes, and names are from the current national hydrologic data set (NHD). There are 170 watersheds identified as Key Watersheds in the three National Forests. These Key Watersheds are located in 19 of the 22 subbasins that include National Forest System lands in the Blue Mountains. Key watersheds comprise 947,000 acres, or 57 percent of the area of the Malheur National Forest; 800,000 acres, or 57 percent of forest area in the Umatilla National Forest; and, 1,270,000 acres or 71 percent of forest area in the Wallowa-Whitman National Forest. From this set of Key Watersheds, 70 are identified as priorities for restoration, of which 27 are within the Malheur National Forest, 16 are within the Umatilla National Forest, and 27 are within the Wallowa-Whitman National Forest. Priority Watersheds occupy 430,000 acres (25 percent) of the Malheur National Forest, 260,000 acres (19 percent) of the Umatilla National Forest and 325,500 acres (18 percent) of the Wallowa-Whitman National Forest.

The WCF process has resulted in the selection of 10 subwatersheds as priorities for restoration (WCF-P in Figure 8 and Tables 1-3, Attachment A) over the 5-year period beginning in 2011. All 10 had been previously selected as key watersheds and 9 of 10 were identified as restoration priorities.

Relationship With Key Watershed Network

The Key Watershed network serves as a broad-scale, long-term (multiple decades or more) strategic network of watersheds focused on the conservation and restoration of aquatic and riparian ecosystems and water quality. Priority Watersheds are a subset of the Key Watersheds with the intention of prioritizing restoration in the plan period (15 years). WCF Priority Watersheds are yet another subset of watersheds generally chosen from the set of Priority Watersheds, wherein near-term (~5 years) restoration actions are focused. The Key Watershed network and Priority Watersheds are expected to remain relatively unchanged during the life of the Forest plan, whereas WCF Priority Watersheds are expected to change fairly frequently (e.g., perhaps as frequently as every couple of years), depending on the scope of needed restoration work and the pace of implementation.

This approach will continue to be used by the National Forests to achieve the long-term strategic goals (desired conditions) of the Forest Plans, while facilitating near-term restoration planning and implementation at a finer spatial scale.

Changing Priority Watersheds

Updates to the Priority Watersheds may be made by administrative change at any time. It is expected that restoration priorities will change over time, depending on changed conditions, disturbance (including fires and flood events), changes in available funding, or changes in the priorities of partner agencies. The WCF process is expected to be repeated at roughly 5-year intervals so that there are always near-term (~5 year) and longer term (10-15 year) restoration goals. The WCF process allows for restoration priorities outside of the key and priority watershed network if circumstances warrant and with public notification of the change (36 CFS 219.8(f)).

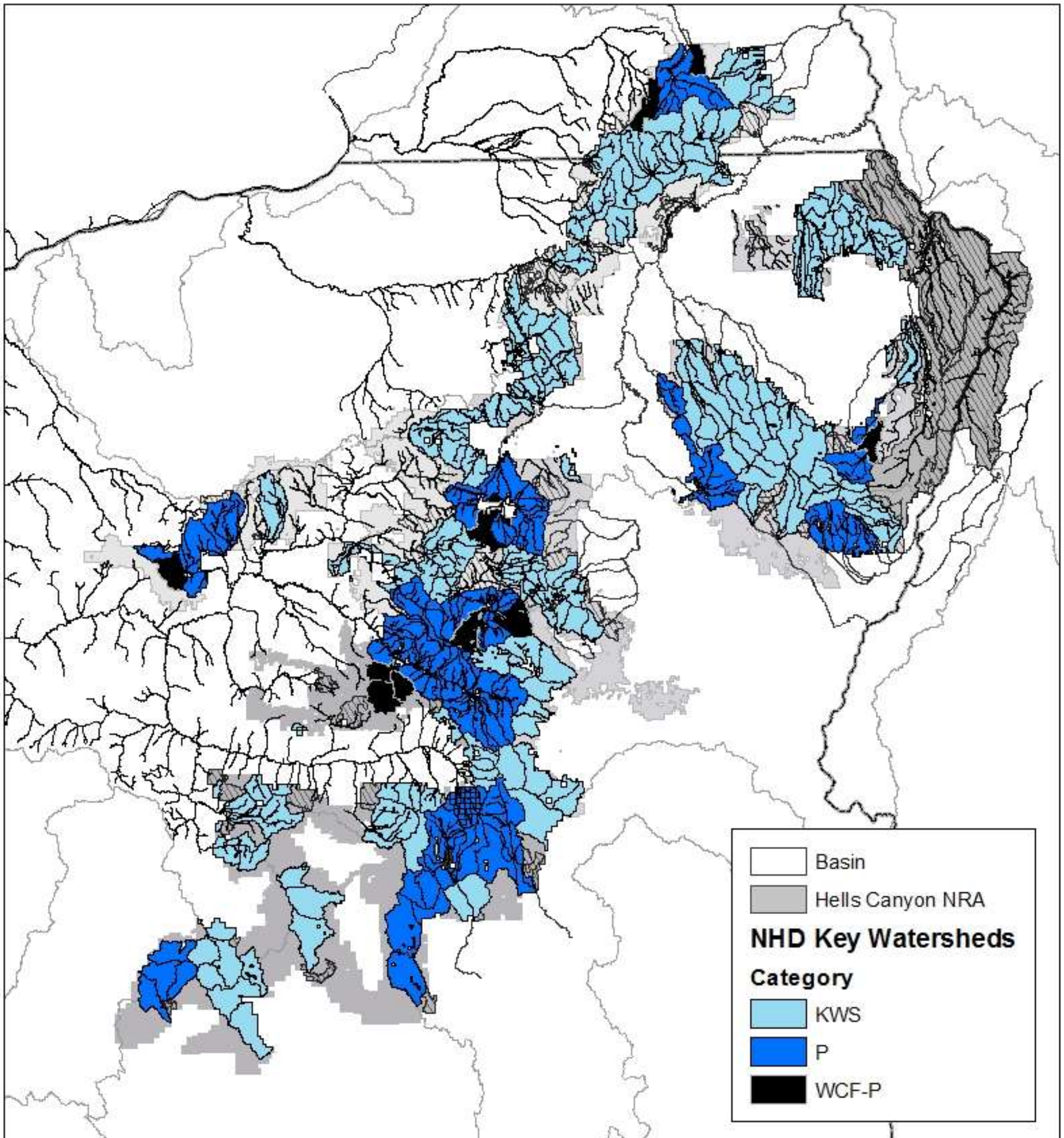

Figure 9. Map of Key Watersheds on National Forests of the Blue Mountains. KWS = Key Watershed, P= Priority Watersheds, WCF-P= Watershed Condition Framework Priority Watersheds. Stream lines display critical habitat for chinook salmon, steelhead, and bull trout (undifferentiated by species). Cross-hatched areas are roadless or designated wilderness areas.

6. The Blues ARCS and Forest Plans

During the length of time this Planning effort has been underway (2003-Present), there have been several attempts to revise the Planning Rule. Presently, the 2012 Planning Rule is in place; however, in that Planning Rule there is transition language (36 CFR 219.17 (b) (3), that allows planning efforts already underway to use the prior planning regulation, which in this case is the 1982 Planning Rule. Definitions for plan components and other plan content use in the ARCS, are derived from both the 1982 (36 CFR 219.3) and 2012 Planning Rule (36 CFR 219.7). Some of the concepts were not in place in 1982; where there are not equivalent definitions in the 1982 Planning Rule, the 2012 Planning Rule has been included. Additionally, the 2012 Planning Rule requires all Forest Plans to be in compliance with the new Rule. Therefore, the structure of the Monitoring Plan and reference to requirements come directly from the 2012 Planning Rule.

Elements of the Blues ARCS will be incorporated into a suite of plan components by:

- Setting *goals* and *desired conditions*,
- Identifying *suitable uses* or activities that are or are not generally appropriate in certain *management areas*,
- Describing anticipated outputs in the form of objectives that are a means to measure progress towards achieving or maintaining desired conditions,
- Constraining activities with *standards* or *guidelines* that ensure protection of physical and biological resources.
- Conducting *monitoring and evaluation* that will provide a basis for a periodic determination and evaluation of the effects of management practices.

Each part of the strategy and its means of implementation are important. However, these individual elements should not be viewed in isolation, as all parts of the strategy, the plan and other plan content work together to guide and constrain management to achieve the desired conditions. Details regarding how they will be used to implement the Blues ARCS are provided in Sections 6-11.

Multiple plan components will be used to implement the Blues ARCS via Forest plans, as described in this section. These plan components include desired conditions, management areas, suitability, objectives, and standards and guidelines, as defined in Section 7. Other plan content (e.g., watershed analysis, restoration, monitoring and adaptive management) will be equally important in implementing the Blues ARCS.

Projects and activities authorized after approval of the revised forest plan must be consistent with the applicable plan components. A project or activity approval document must describe how the project or activity is consistent with applicable plan components and meets the following criteria:

1. **Goals, desired conditions, and objectives**. The project or activity contributes to the maintenance or attainment of one or more goals, desired conditions, or objectives, and does not appreciably impede progress toward maintaining or achieving any goals, desired conditions, or objectives, over the life of the plan.

2. **Standards**. The project or activity complies with applicable standards.
3. **Guidelines**. The project or activity:
   a. Complies with applicable guidelines as set out in the plan; or
   b. Is designed in a way that is as effective in achieving the purpose of the applicable guidelines (§ 219.7(e)(1)(iv)).).).
4. **Suitability**. A project or activity would occur in an area:
   a. That the plan identifies as suitable for that type of project or activity; or
   b. For which the plan is silent with respect to its suitability for that type of project or activity.

It is not expected that all projects or activities will contribute to all desired conditions and objectives. It should also be recognized that some projects designed to contribute to some desired conditions and objectives may have consequences considered adverse to the achievement of other desired conditions and objectives. In this situation, the responsible official needs to identify and disclose those effects and determine whether those effects will appreciably reduce the opportunity to maintain or achieve any goals, desired conditions, or objectives, over the life of the plan. If the project or activity is found to appreciably reduce opportunities to maintain or achieve any goals, desired conditions, or objectives over the long term, it is not consistent with the forest plan.

Where a project or activity is proposed that is not consistent with the plan, the responsible official has the following options:

1. Modify the proposal so that the project or activity will be consistent.
1. Reject the proposal.
   Amend the plan simultaneously with the approval of the project or activity so that the project or activity is consistent with the plan as amended. The amendment may be limited to apply only to the project or activity.

Goals and Desired Conditions

Definitions:

- 36 CFR 219.3 (1982) Definitions and terminology. ***Goal.*** A concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms and is timeless in that it has no specific date by which it is to be completed. Goal statements form the principal basis from which objectives are developed.

- 36 CFR 219.7 (i) (2012) ***Desired conditions***. A desired condition is a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates.

Goals and Desired conditions Goal statements set forth a broad framework and theme for the plan and form the basis for desired conditions. For each goal, there are several desired condition statements which more specifically describe what conditions are needed for attaining goals. Desired conditions are at the heart of forest plans. They describe the aspirations or visions of what the plan area (or portions thereof) should look like in the future. Desired conditions essentially set forth the desired landscape of the future. They also provide the foundation and drive the development of most other plan components. For example, the Forest Plan includes objectives, standards, and guidelines that are designed to achieve or maintain desired conditions.

To be consistent with the desired conditions of the plan in assessing a project or activity, at the appropriate spatial scale described in the plan (e.g., landscape scale), each project or activity must be designed to meet one or more of the following conditions:

- Maintain or make progress toward one or more of the desired conditions of a plan without adversely affecting progress toward, or maintenance of, other desired conditions; or
- Be neutral with regard to progress toward plan desired conditions, except as specified in standards or guidelines; or
- Maintain or make progress toward one or more of the desired conditions over the long term, even if the project or activity would adversely affect progress toward or maintenance of one or more desired conditions in the short term; or
- Maintain or make progress toward one or more of the desired conditions over the long term, even if the project or activity would adversely affect progress toward other desired conditions in a negligible way over the long term.

The project documentation should explain how the project is consistent with desired conditions and describe any short-term or negligible long-term adverse effects the project may have on the maintenance or attainment of any desired condition.

Achieving desired conditions will vary in both time and space. Some desired conditions may be achievable over a long timeframe (in some cases, several hundred years); whereas, in other cases the desired condition already matches the current condition, and the desire is to maintain it. In addition, each desired condition has a scale. Some desired conditions apply at the Forestwide scale, while others apply at a subbasin, watershed, subwatershed, or management area scales. Desired conditions are aspirations and are not intended to be commitments that will be achieved during the life of the plan.

In the Plan, a brief background description and a brief existing condition description of each desired condition are provided, followed by the desired condition and statement of scale. The background and existing condition descriptions are provided for information only. They are not plan direction.

General Forest-Wide Desired Conditions

The general Forest-wide desired conditions described in this section apply at larger (e.g., watershed) scales, not at particular sites. The national hydrologic unit (HU) is the basis for defining the specific scales at which the general Forest-wide desired conditions apply. The three watershed scales most relevant to implementation of the Forest plan are: subbasin (8-digit HU), watershed (10-digit HU), and subwatershed (12-digit HU). Individual project assessments often use data collected at finer scales such as the subwatershed, drainage, valley segment, site, stream reach or scale.

Forestwide desired conditions pertaining to riparian areas, water, water quantity and quality are described below. The scale(s) at which these generally apply to Forest planning and project planning are identified after each desired condition.

Watershed Function DC-1. The watershed-scale processes that control the routing of water, sediment, wood, and organic material operate at levels that support native aquatic species and the proper function of their habitat and do not require human intervention or restoration. **Scale**: Watershed or Subwatershed.

Watershed Function DC-2. The distribution, diversity, and complexity of watershed features (i.e., submerged and overhanging large wood, log jams, and beaver dams, side channels, pools, undercut banks and embedded substrates) and natural processes provide aquatic and riparian ecosystems to which species, populations, and communities are uniquely adapted. **Scale**: Subbasin.

Watershed Function DC-3. Connectivity exists within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide unobstructed routes to areas critical for fulfilling all life history requirements of aquatic, riparian-dependent, and upland species of plants and animals. **Scale**: Connectivity is within and between watersheds at the subbasin scale for forestwide planning; between subwatersheds at the watershed scale for project planning.

Watershed Function DC-4. Aquatic and riparian ecosystems resilient to the effects of climate change and other major disturbances. **Scale**: Subbasin for Forest planning and watershed scale for project planning.

Hydrologic Function DC-1. Flow regimes, including water yield, timing, frequency, magnitude, and duration of runoff, are sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of movement of sediment, nutrients, and wood. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows are within the natural range of variability in which the system developed. **Scale**: Watershed.

Hydrologic Function DC-2. The timing, variability, and duration of floodplain inundation, water table elevation in wetlands, seeps, and springs, and subsurface water connectivity are within the natural range of variability. **Scale**: Watershed and Subwatershed.

Wetland DC-1. The extent and diversity of wetland types is maintained or increased. **Scale**: Subbasin.

Wetland DC-2. The surface and subsurface flow paths that support wetland habitats are undisturbed. The timing and duration of inundation of wetlands are within natural ranges. Plant species composition in wetlands is characteristic of the biophysical setting in which they occur. **Scale**: Subwatershed.

Ground-Water Dependent Ecosystem DC-1. The ecological structure and function of springs, peatlands and groundwater fed wetlands are maintained or restored. **Scale**: Subwatershed.

Ground-Water Dependent Ecosystem DC-2. The aquifer supplying water to groundwater-dependent ecosystems is not being affected by groundwater withdrawal or loss of recharge. Soils of groundwater dependent ecosystems are intact and functional; erosion and deposition are within the natural range. Runout channels, if present, are functioning naturally and are not entrenched, eroded, or substantially altered. Vegetation is composed of the anticipated cover of plant species associated with the site environment; hydric species are present and are not replaced by upland species. Livestock herbivory and trampling are not adversely affecting sites. **Scale**: Subwatershed.

Ground-Water Dependent Ecosystem DC-3. Vegetation is composed of the expected cover of plant species associated with the site environment; hydric species are present and are not replaced by upland species. Livestock herbivory and trampling are not adversely affecting sites. **Scale**: Subwatershed.

Stream Channel Function DC-1. The sediment regime under which aquatic ecosystems evolved is maintained, including the timing, volume, rate and character of input, storage, and transport. **Scale**: Watershed.

Stream Channel Function-2. The physical integrity of the aquatic system, including shorelines, banks, and bottom configurations, are properly functioning and in dynamic equilibrium with the flow and sediment regimes under which aquatic systems have evolved. **Scale**: Subwatershed to watershed.

Stream Channel Function DC-3. Channel morphology, structure, complexity, and diversity are in ranges that are characteristic of the local geology, climate, and geologic processes. **Scale**: Watershed.

Stream Channel Function DC-4. Channel-floodplain connections are intact. Channel bed and bank erosion rates are within natural ranges and do not result in degraded aquatic or riparian habitats or channel alteration. **Scale**: Subwatershed to Subbasin.

Stream Channel Function DC-5. Measures of channel stability and morphology, including width/depth ratio, bank stability, and bank angle are within reference ranges and matches the frequency distribution of reference sites for a given channel type and channel size. **Scale**: Subwatershed to Subbasin.

Stream Channel Function DC-6. Large wood frequency and volume are within the range of variation and potential for streams in individual watersheds. The spatial and temporal distribution of wood in individual streams varies depending on valley, riparian, and channel characteristics and the disturbance processes (fire, flood, debris flow) responsible for transferring material from hillslopes to streams. The frequency distribution of large wood among individual streams is similar to the frequency distribution of reference sites. **Scale:** Watershed.

Stream Channel Function DC-7: In forested watersheds, the distribution and frequency of wood forced channel morphology (forced step pool and forced pool riffle streams), in which the majority of pools are formed by individual pieces or accumulations of large wood, and wood-rich pool riffle streams (Montgomery et al. 1995) is comparable to the distribution in reference watersheds. **Scale:** Watershed.

Stream Channel Function DC-8: The frequency distribution of stream channel and habitat conditions for any given attribute, approaches the frequency distribution of reference conditions for the same attribute in similar channel types. **Scale:** Watershed to sub-basin.

Stream Channel Function DC-9: Pool frequency, size, depth, and volume are within ranges expected of given channel and valley types. **Scale:** Subwatershed to watershed.

Stream Channel Function DC-10: Bank erosion is within a range that does not degrade aquatic or riparian habitats or that leads to channel alteration. **Scale:** Subwatershed to subbasin.

Aquatic Function DC-1. Aquatic habitats contribute to ecological conditions capable of supporting self-sustaining populations of native species and diverse plant, invertebrate, and vertebrate aquatic and riparian-dependent species. Aquatic habitats are key for the recovery of threatened and endangered fish species and provide important habitat components for all native aquatic species. **Scale**: Subwatershed to Subbasin.

Aquatic Function DC-2. National forest system lands contribute to the protection of population strongholds for state classified sensitive species, and narrow endemics, federally listed or proposed threatened and endangered species, and designated critical habitats. These strongholds provide high quality habitat (e.g., spawning/rearing/over-wintering areas, and critical habitats, including migratory corridors) and support expansion and re-colonization of species to adjacent watersheds, and function in a manner that is resilient to natural disturbance regimes. These areas conserve key demographic processes likely to influence the persistence of populations or metapopulations. Areas adjacent to these high quality habitats are restored (as appropriate) and protected to help ensure adequate connectivity, species distribution, and the maintenance or restoration of fully functioning habitats for all life histories of aquatic species. **Scale:** Subwatershed to Subbasin.

Aquatic Function DC-3. Aquatic habitat elements (e.g., substrate, pools, cover, food, water quality and quantity) are in properly functioning and are sufficiently distributed to ensure egg and embryo survival, fry emergence, and juvenile survival of aquatic species to support self-sustaining populations of native resident and anadromous fish. Spawning and rearing areas contain a minimal amount of fine sediment, ranging in size from silt to coarse sand. **Scale**: Subwatershed to Subbasin.

Aquatic Function DC-4. Native fish species have access to historically occupied aquatic habitats and connectivity between habitats allows for the interaction of local populations. Migratory habitats support juvenile and adult mobility and survival between spawning, rearing, overwintering, and foraging habitats that contain areas that:

- are free of obstruction and excessive levels of predators of federally listed aquatic species;
- have minimal physical, biological, or water quality and quantity impediments (including permanent, partial, intermittent, or seasonal barriers); and
- contain natural cover such as large wood, aquatic vegetation, rocks and boulders, side channels, and undercut banks.

Scale: Subwatershed to Subbasin.

Aquatic Function DC-5. The transfer of wood, sediment, nutrients, and other material that occurs following fires, wind storms, floods, and other natural disturbances is capable of creating and maintaining the range and diversity of riparian and aquatic habitat conditions that occurs in reference watersheds. **Scale:** Watershed.

Aquatic Function DC-6. The potential for large wood recruitment to streams from within forested riparian areas, and from low-order streams to higher-order streams, is similar to the potential in reference watersheds containing the same (riparian) forest vegetation types. (This partly restates WF-1, but is more explicit). **Scale**: Watershed.

Aquatic Function DC-7. Aquatic habitats in which the distribution of conditions (e.g., bank stability, substrate size, pool depths, size and frequencies, channel morphology, large woody debris size and frequency) in the population of watersheds on the Forest is similar to the distribution of conditions in the population of similar, reference condition watersheds. The distribution of conditions in individual streams vary depending on valley, riparian, and channel characteristics. **Scale:** Reference Conditions can be drawn from the Forest or Provincial scales. Conditions assessed at the subbasin scale for Forest and project planning.

Aquatic Function DC-8. Aquatic and riparian ecosystems are resilient to the effects of climate change and other major disturbances. **Scale**: Subbasin scale for Forest planning and watershed scale for project planning.

Species Diversity DC-1. The natural range of habitats for native and desired nonnative fish, wildlife, and plant species, including threatened and endangered species, species identified as regional forester's sensitive species, and surrogate species, is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity. This includes the ability of species and individuals to interact, disperse, and find security within habitats in the planning area. These habitat conditions are resilient and sustainable considering the range of possible climate change scenarios. **Scale:** The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections.

Species Diversity DC-2. Population strongholds for the fish surrogate species provide high quality habitat and support expansion and recolonization of species to adjacent unoccupied habitats. These areas conserve key demographic processes likely to influence the sustainability of aquatic species. **Scale:** The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections.

Species Diversity DC-3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish exist. Low levels of occurrence of nonnative predatory, interbreeding, or competing species exist, and if present, they are temporally and spatially isolated from federally listed species. **Scale:** The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections.

Species Diversity DC-4. Specialized habitat components, such as caves, standing dead trees, seeps, and springs, are found across the landscape in amounts and types commensurate with the natural communities in which they occur. **Scale:** The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections.

Species Diversity DC-5. Management activities improve the conservation status of species identified as being surrogate species or of local or regional conservation concern. Habitats and populations are managed in accordance with conservation planning documents, recovery plans, best available scientific information, and local knowledge. **Scale:** The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections.

Federally Listed Species DC-1. Federally listed species (aquatic and terrestrial) are recovered or delisted. Management activities improve the conservation status of listed species and designated critical habitat. Habitats are managed in accordance with conservation planning documents, recovery plans, best available scientific information, and local knowledge. Critical habitat components (i.e., Primary Constituent Elements and Primary Biological Features) are protected and restored to achieve species recovery.

- For listed aquatic species, on NFS lands spawning, rearing, and migratory habitat is widely available and inhabited. Listed aquatic species have access to historic habitat and appropriate life history strategies (i.e., resident, fluvial, adfluvial and anadromy) are supported. Recovery is promoted through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups.
- For listed terrestrial species, habitat that adequately provides ample resources for all life stages is available and inhabited. Recovery is promoted through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups.
- For listed plant species, threats such as invasions by aggressive, nonnative plants, adverse livestock grazing management, and changes in fire frequency and seasonality are addressed. Populations achieve recovery through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups.

Scale: A variety of spatial scales and hydrologic boundaries (ranging from individual projects to subwatersheds to areas as large as populations). Species recovery plans identify activities necessary for recovery at the project (reach), subwatershed and population scales. Species' recovery plans further describe high-priority restoration actions at these scales that address identified limiting factors and threats to listed species and designated critical habitats.

Invasive Species DC-1. Healthy, native and desired nonnative animal communities, and native and desired nonnative plant communities dominate the landscape and are resilient given current and projected climate conditions. Invasive species and other undesirable species (terrestrial and aquatic plants and animals) are absent or occur in small areas and have limited or no impacts on viability of native and desired nonnative species. Existing invasive and undesirable species do not expand their current distributions over the life of the Plan, and their current distributions will be reduced to the extent possible over that period of time. Invasive and undesirable species do not significantly diminish the ability of the national forests to provide the goods and services communities expect or the habitat that plant and animal community diversity depends upon. New invasive species resulting from changes in plant and animal habitats due to changes in climate occur only at low levels. **Scale**: Watershed.

Water Use DC-1. Water is available in sufficient quantity and quality to meet downstream human needs as well as the needs of aquatic species considering the range of possible climate change scenarios. **Scale**: Watershed to Subbasin.

Water Use DC-2. Water quality and quantity of groundwater resources, including seeps, springs, fens, and other groundwater-dependent ecosystems, is sufficient to provide for the extent and diversity of species associated with these habitats. **Scale:** Watershed to Subbasin.

Water Quality DC-1. Water quality (e.g., temperature, turbidity, and dissolved oxygen) of surface and groundwater is sufficient to support healthy riparian, aquatic, and wetland ecosystems. It is within the range that maintains the biological, physical, and chemical integrity of the system and is capable of benefiting the survival, growth, reproduction, and mobility of individuals composing aquatic and riparian communities. **Scale**: Watershed.

Water Quality DC-2. The quality of water within and emanating from the national forests is sufficient to provide for state-designated beneficial uses, including human uses and meets applicable local, state, and tribal water quality criteria. **Scale**: Subbasin.

Desired Conditions for Key Watersheds and subwatersheds with ESA critical habitat for aquatic species

Key Watershed DC-1. Connected networks of watersheds with ecological form, function and processes, and functionally intact ecosystems contribute to and enhance conservation and recovery of specific threatened or endangered fish species and provide high water quality and quantity. The networks contribute to short-term conservation and long-term recovery at the major population group, core area or other appropriate population scale. **Scale**: Watershed to Subbasin.

Key Watershed DC-2. Roads in key watersheds present minimal risk to aquatic resources. **Scale**: Subwatershed.

Key Watershed DC-3. Key watersheds have high watershed integrity and provide resilient aquatic and riparian ecosystems. **Scale**: Subwatershed.

Desired Conditions for Riparian Management Areas

Riparian Management Area DC-1. Riparian management areas (RMAs) within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical, and biological conditions appropriate to natural disturbance regimes affecting the area. **Scale**: Subwatershed.

Riparian Management DC-2. The species composition and structural diversity of native plant communities in riparian management areas, including wetlands, provides adequate side channels, pools, undercut banks and unembedded substrates. These conditions result in a variety of depths, gradients, velocities, and structure for seasonal thermal regulation, nutrient filtering, appropriate rates of erosion, and channel migration and supplies amounts and distributions of coarse woody debris and fine particulate organic matter sufficient to sustain physical complexity and stability. **Scale**: Watershed scale for forestwide planning; subwatershed scale for project planning.

Riparian Management Area DC-3. Key riparian processes and conditions (including slope stability and associated vegetative root strength, bank stability, wood delivery to streams, and, within the riparian management areas, input of leafy and other organic matter to aquatic and terrestrial systems, solar shading, microclimate, and water quality) are operating consistent with natural disturbance regimes. **Scale**: Subwatershed.

Riparian Management Area DC-4. Riparian vegetation has the species composition, structural diversity, age class diversity, and extent that is characteristic of the setting in which it occurs and the hydrologic and disturbance regimes in which it developed. The condition and composition of small habitat patches may change over small temporal and spatial scales but remains relatively constant at larger scales. Plant communities are similar in species composition, age class structure, canopy density, and ground cover to plant associations (Crowe and Clausnitzer 1997) that are representative of a particular setting. **Scale**: Subwatershed to subbasin.

Riparian Management Area DC-5. Riparian shrub communities occupy their historical range and extent. Individual plants are capable of reaching the full potential for a typical individual of a particular species, as defined by plant height, width, and growth form. Individual plants are able to propagate, or reproduce, vegetatively and/or sexually. Plant communities are similar in species composition, age class structure, canopy density, and ground cover to plant associations (Crowe and Clausnitzer 1997) that are representative of a particular setting. **Scale**: Subwatershed.

Riparian Management Area DC-6. Riparian areas consist of native assemblages of riparian-dependent plants and animals free of persistent non-native species and provide for dispersal and travel corridors, as well as connectivity, between geographically important areas for both terrestrial and aquatic animals and plant species within the planning area. **Scale**: Subwatershed.

Riparian Management Area DC-7. The potential for large wood recruitment to streams from within forested riparian areas, and from low-order streams to higher order streams, is similar to the potential in reference watersheds with similar forest vegetation types. **Scale**: Watershed.

Objectives

Definition:

- 36 CFR 219.3 (1982) **Objective.** A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

The objectives represent some of the expected outcomes for the Forest to make progress towards desired conditions.

Objectives are projections of Forest Service activities and program outcomes that are measurable and time specific. Like goals and desired conditions, objectives are not commitments or final decisions approving projects or activities. They are an effort by the Forest Service to share with the public the way progress toward achieving or maintaining the desired conditions during the life of the plan will be measured. The objectives stated are only a partial list of the management activities expected to be accomplished to contribute to maintaining or achieving desired conditions.

Objectives are based on ecological needs, community capacity, and expected funding, including budgets, partnerships, and cooperative agreements. The actual accomplishments will be dependent on actual funding, staffing levels, and local infrastructure. The objectives are not intended to limit or guarantee the amount of work that will be accomplished. More work may be accomplished if additional infrastructure or funding, such as increased budget allocations, partnerships, or other external sources, becomes available. Less work could occur if funding is less than expected, additional infrastructure is not constructed, or existing infrastructure declines and becomes unusable.

Objectives are expected to be accomplished during the first decade of the plan period, unless otherwise indicated within the objective statement. The objectives reflect the activities and program outcomes necessary to achieve or maintain desired conditions. Objectives are displayed for each the Blue Mountains national forests in the following table. The table displays the portion of the Ochoco administered by the Malheur as part of the Malheur.

Watershed Restoration

The Forests have identified watershed restoration objectives relevant to conditions that pose substantial risk and consequence to maintaining or attaining aquatic and riparian desired conditions. The management actions to meet these objectives should be achievable within the life of the plan (15 years).

Objectives for individual restoration treatments were developed that outline the general scope/magnitude of projected treatments and their general locations. These could include, but are not limited to the following:

- soil and water resource improvements
- fish passage improvements
- instream habitat improvements
- riparian/floodplain vegetation treatments
- road and trail improvements focused on watershed and aquatic resources
- road storage treatments and road decommissioning

In developing objectives, the highest priorities for restoration include the removal of major factors posing risks to the integrity/resiliency of watersheds and riparian and aquatic ecosystems.

Objective Statements	Malheur	Umatilla	Wallowa-Whitman
1.1 Watershed Function[2]			
Improve riparian and wetland function by: • Restoring floodplain connections, channel morphology, channel structure, and flow regime (flood flows and low flows) (stream miles) (WR1)	80 miles	90 miles	90 miles
• Restoring riparian/wetland species composition (riparian acres) by increasing natural seedling establishment, planting, fencing, or modifying riparian management (riparian acres) (WR2)	300 acres	165 acres	225 acres
• Increasing effective stream shade (WQ objective 1) by increasing amount and extent of woody riparian species and increasing age-class structure of terrestrial vegetation in MA 4 (stream miles) (WR3)	450 miles	225 miles	375 miles
Improve riparian and wetland function by: • Increasing extent and vegetative species diversity of off-channel and isolated wetlands by restoring hydrologic pathways, modifying existing water diversions, or fencing (number of sites) (WR4)	30 sites	40 sites	40 sites
• Increasing the number and extent of beaver-created wetlands (sites)	12 sites	10 sites	12 sites
Improve stream channel and aquatic habitat function by: • Improving riparian habitat conditions (riparian acres, WR1-3)	600 acres (annually)	525 acres (annually)	675 acres (annually)
• Restoring channel morphology to reflect natural conditions (miles)	38 miles	45 miles	60 miles
• Increasing habitat complexity through channel reconstruction, placement of large wood or other structures, habitat enhancement (miles)	75 miles	90 miles	113 miles
• Increasing aquatic habitat connectivity through culvert replacement (number of culverts)	90 culverts 143 stream miles	75 culverts 68 stream miles	90 culverts 135 stream miles

Objective Statements	Malheur	Umatilla	Wallowa-Whitman
(W1) Increase the number of watersheds in condition class 1 (from CC2) and 2 (from CC3) through active restoration. Measure: number of subwatersheds (HUC6) with improved condition.	16 watersheds	14 watersheds	24 watersheds
Improve hydrologic function by: • Improving forest vegetative conditions (acres) (WH1)	7,800 acres (annually)	6,600 acres (annually)	7,300 acres (annually)
• Improving soil hydrologic function in areas of detrimental soil disturbance (acres) (WH2)	600 acres	750 acres	950 acres
• Reducing road-related sedimentation by reducing road density and reducing hydrologic connectivity of the road system (road miles) (WH3)	30-35 miles road surface treated (annually)	30-35 miles road surface treated (annually)	30-35 miles road surface treated (annually)
1.2 Species Diversity			
In cooperation with state fish and wildlife agencies, expand bull trout occurrence within 10 years into unoccupied suitable stream segments within its historic range.	1 segment	1 segment	1 segment
Restore habitat quality and connectivity within and between stronghold watersheds for aquatic species, with emphasis on strongholds for ESA-listed aquatic species.	4-6 subwatersheds or 80-120 stream miles	3-5 subwatersheds or 60-100 stream miles	6-9 subwatersheds or 120-180 stream miles
1.7 Plant Species Composition			
Develop habitat management plans for Spalding's Catchfly key conservation areas.	N/A	Lick Creek key conservation area (also called Blue Mtn. Foothills)	Lower Imnaha, Crow Creek, and Clear Lake Ridge key conservation areas
1.10 Soil Quality			
Implement erosion control and stabilization measures on unstable hillslopes. Possible activities include road realignment and improving forest vegetation conditions.	200-400 acres	200-400 acres	150-250 acres
Restore soil function (also see objectives for 1.1 Watershed Function).	175-350 acres	175-350 acres	75-150 acres
1.11 Water Quality			
Improve water quality through implementation of water quality restoration plans.	4-6 watersheds 160-240 stream miles	5-7 watersheds 200-280 stream miles	5-7 watersheds 200-280 stream miles

Standards and Guidelines

Definition:

- 36 CFR 219.7 (2012) (iii) **Standards**. A standard is a mandatory constraint on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

- 36 CFR 219.7 (2012) (iv) **Guidelines**. A guideline is a constraint on project and activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met. (§ 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

General Riparian Management

Standard RMA-1S. Riparian Management Areas include portions of watersheds where aquatic and riparian-dependent resources receive primary management emphasis. When riparian management area desired conditions are functioning properly, projects shall protect or maintain those conditions. When riparian management area desired conditions are not yet achieved or riparian management areas have impaired function or are functioning-at-risk and to the degree that project activities would contribute to those conditions, projects or permitted activities shall restore or not retard attainment of desired conditions.[2] Short-term adverse effects from project activities may occur when they support long-term recovery of riparian management area desired conditions.[3] Exceptions to this standard include situations where Forest Service authorities are limited (Alaska National Interest Lands Conservation Act {ANILCA}, 1872 Mining law, valid state water right, etc.). In those cases, project effects towards attainment of riparian management area desired conditions shall be minimized and not retard attainment of desired conditions to the extent possible within Forest Service authorities. Use ARCS Attachment 2 (e.g. diagnostic indicators and RMA ecological process and function descriptions) to assist in determining compliance with this standard.

Standard RMA-2S. Herbicides, insecticides, pesticides and other toxicants, and other chemicals shall be applied only to maintain, protect, or enhance aquatic and riparian resources or to restore native plant communities in a manner that does not harm aquatic or riparian resources.

Standard RMA-3S. Trees felled for safety shall be retained onsite unless in excess of what is needed to achieve aquatic and riparian desired conditions. If the desired quantity and size

[2] Per Watershed Condition Framework Technical Guide, USDA Forest Service (2011b), subsequent versions of this guide and/or other comparable methods. The Watershed Condition Class terminology for functioning properly, “functioning-at-risk”, and impaired function are equivalent to “functioning appropriately” or “, “functioning-at-risk” and “functioning at unacceptable risk” functioning categories within the matrix of pathways and indicators (USFWS 1998, and respectively equivalent to “Properly Functioning” or “At Risk” or “Not Properly Functioning” categories within the matrix of pathways and indicators used by NMFS (1996).

[3] The definitions and rationale for the terms maintain, restore, degrade, retard attainment, short-term, and long-term are included in Forest Plan standard WM-1.

distribution of large wood has been met on site, the wood can be transported to other aquatic and riparian restoration projects.

Guideline RMA-4G. Water drafting sites should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat. To prevent the spread of invasive species, water should not be discharged into other water bodies.

Standard RMA-5S. Pumps shall be screened at drafting sites to prevent entrainment of fish and shall have one-way valves to prevent back-flow into streams.

Guideline RMA-6G. Fish habitat and water quality should be protected when withdrawing water for administrative purposes.

Standard RMA-7S. Refueling shall occur with appropriate containment equipment and a spill response plan in place. Wherever possible, storage of petroleum products and refueling will occur outside of RMAs. The use of containment devices, absorbent pads, and a developed spill plan will help reduce the risk of fuel and petroleum products from getting into streams and other waterways if an accident were to occur. If refueling or storage of petroleum products is necessary within RMAs, these operations will be conducted no closer than 100 feet from waterways.

TIMBER MANAGEMENT IN RIPARIAN MANAGEMENT AREAS

Standard TM-1S. Silvicultural treatments shall occur in riparian management areas only as necessary to maintain, enhance or restore conditions for aquatic and riparian resources. When conducted, these activities shall avoid or minimize adverse effects to aquatic and riparian resources. Vegetation in riparian management areas shall not be subject to regularly scheduled timber harvest; since they are not part of our timber suitability landbase.

Standard TM-2S. Fuelwood cutting shall not be authorized in RMAs unless specifically designed to attain aquatic and riparian desired conditions.

Guideline TM-3G. Use of existing or construction of new landings, designated skid trails, staging, and decking should not occur in riparian management areas, unless they are associated with projects designed to improve riparian management areas conditions. These features should:

- be of minimum size,
- be located outside the active floodplain, and
- avoid negative effects to large wood, bank integrity, temperature, and sediment levels.

Guideline TM-4G. Yarding activities should achieve full suspension over the active channel; unless other alternatives will have less damage to riparian areas and stream channels.[4]

Standard TM-5S. Silvicultural practices shall include provisions, as appropriate, to avoid detrimental changes in water temperatures, blockages of water courses; including protection for streams, stream banks, shorelines, lakes, wetlands, and other bodies of water, and deposits of sediment.

Standard TM-6S. Silvicultural practices shall include provisions (e.g. BMPs) for the maintenance or restoration of soil resources.

Standard TM-7S. Timber harvest on lands not suitable for timber production shall occur only to meet desired conditions for each management area other than timber production.

Guideline TM-8G. In watersheds in which stream channels and aquatic habitats are in properly functioning condition, forest vegetation within RMAs should be managed to maintain or increase large wood recruitment and delivery to streams.

Standard TM-9S. In watersheds in which stream channels and aquatic habitats are not in properly functioning condition, and where instream wood frequency and volume are below reference conditions and/or site potential, manage forest vegetation within RMAs to maintain or increase large wood recruitment and delivery to streams.

ROADS MANAGEMENT IN RIPARIAN MANAGEMENT AREAS

Guideline RF-1G. New designated routes and trails should not be constructed within riparian management areas unless no other feasible alternative exists.

Guideline RF-2G. Temporary roads, including stream crossings, in RMAs should be minimized. Temporary roads should be constructed to protect and restore aquatic and riparian desired conditions.

Standard RF-3S. Side-casting (placement of unconsolidated earthen waste materials resulting from road construction or maintenance) in riparian management areas shall be avoided.

Standard RF-4S. Fill material shall not be placed on organic debris in riparian management areas.

Standard RF-5S. Disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow shall be avoided when constructing or reconstructing roads or landings either inside or outside of riparian management areas.

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[4] Active channel is the bank full width of flowing perennial or intermittent streams.

Guideline RF-6G. Wetlands and unstable areas should be avoided when reconstructing existing roads or constructing new roads and landings. Minimize impacts where avoidance is not practical.

Standard RF-7S. New or replaced permanent stream crossings shall be designed to allow for the 100-year flood and its bedload and debris. 100-year flood estimates will reflect the best available science regarding potential effects of climate change.

Standard RF-8S. Where physically feasible, construction or reconstruction of stream crossings will avoid diversion of streamflow out of the channel and down the road in the event of crossing failure.

Standard RF-9S. Construction or reconstruction of stream crossings shall provide and maintain passage for all life stages of all native and desired non-native aquatic and riparian-dependent organisms. Crossing designs shall reflect the best available science regarding potential effects of climate change on peak flows and low flows.

Guideline RF-10G. Fish passage barriers should be retained where they serve to restrict access by undesirable nonnative species and are consistent with restoration of habitat for native species.

Guideline RF-11G. Locate roads to minimize delivery of water and sediment from roads to streams. Avoid or minimize disruption of hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow when constructing, reconstructing, and maintenance of roads or landing.

Guideline RF-12G. Road drainage should be routed away from potentially unstable channels, fills, and hillslopes to the extent practicable.

GRAZING MANAGEMENT IN RIPARIAN MANAGEMENT AREAS

Standard GM-1S. Manage livestock grazing to attain aquatic and riparian desired conditions. Where livestock grazing is found to prevent or retard attaining aquatic and riparian desired conditions, modify grazing practices (such as number of livestock, timing, and physical structures). If adjusting practices is not effective, remove livestock from that area using appropriate administrative authorities and procedures.

Standard GM-2S. New livestock handling and/or management facilities shall be located outside riparian management areas unless they do not prevent or retard attaining aquatic and riparian desired conditions.

Guideline GM-3G. The purpose of this guideline is to manage livestock grazing to help attain and maintain aquatic and riparian desired conditions over time. Specifically, it is intended to maintain or improve vegetative and stream conditions, help ensure the viability of aquatic species, provide important contributions to the recovery of ESA-listed species, and facilitate attainment of State water quality standards.

The annual livestock use and disturbance indicators described below should be applied to help achieve, over longer timeframes, conditions at site and watershed scales that enable attainment and maintenance of desired conditions. The values specified below are starting points for management. Only those indicators and numeric values that are appropriate to the site and necessary for maintaining or moving towards desired conditions should be applied.[5] Specific indicators and indicator values should be prescribed and adjusted, if needed, in a manner that reflects existing and natural conditions for the specific geo-climatic, hydrologic and vegetative setting in which they are being applied. Indicators and indicator values should be adapted over time based on long-term monitoring and evaluation of conditions and trends. Alternative use and disturbance indicators and values, including those in current ESA consultation documents, may be used if they are based on best available science and monitoring data and meet the purpose of this guideline.

1. In subwatersheds that are functioning properly [6] for water quality, aquatic habitat, and riparian and wetland vegetation, protect or maintain those conditions by managing annual livestock grazing use and disturbance as follows [7]:
    - maintain a minimum of 6-inch residual stubble height [8] of key herbaceous species on the greenline, except for sites in late-seral conditions,[9] being managed under any grazing system that supports a late-seral ecological stage, where a minimum of 4-inch to 6-inch stubble height should be maintained;

[5] Not all indicators may apply to a particular site. For example, stubble height is a meaningful indicator for lower gradient streams where herbaceous vegetation plays an important role in stabilizing streambanks. It is generally less useful for steeper channels, where channel morphology is controlled by coarse substrates. Moreover, not all numeric values may apply to a particular site (e.g., sites with short graminoids).

[6] Subwatershed classification as "properly functioning", "functioning-at-risk", or "impaired function" should be determined based on a weight-of-evidence approach that considers, at a minimum, the water quality, aquatic habitat, and riparian/wetland vegetation indicators of the Watershed Condition Framework (WCF). WCF "properly functioning", "functioning-at-risk", or "impaired function" descriptions are equivalent to "functioning appropriately", "functioning-at-risk" and "functioning at unacceptable risk" categories within the matrix of pathways and indicators (MPI) used by USFWS (USFWS 1998) and to "properly functioning" or "at-risk" or "not properly functioning" categories within the MPI used by NMFS (NMFS 1996). Where ESA-listed species or critical habitat are present, use ARCS Attachment B (MPI) to determine conditions for water quality, aquatic habitat, and riparian/wetland vegetation indicators. Only WCF and MPI information relevant to livestock grazing need be considered. Local inventory, assessment and monitoring data and information can be used to refine initial classifications made per WCF or MPI.

[7] Per Pacfish/Infish Monitoring, Multiple Indicator Monitoring (BLM Technical Reference 1737-23) protocols or comparable methods for stubble height, streambank alteration, and use of woody species. Per Bureau of Land Management protocols (BLM/RS/ST-96/004+1730) or comparable methods for herbaceous utilization.

[8] Stubble height criteria apply at the end of the grazing period, when that period ends after the growing season. When the grazing period ends before the growing season does, stubble height criteria can be applied at the end of the grazing period or the end of the growing season.

[9] Late seral condition means the existing riparian vegetation community is similar to the potential natural community composition (per Winward 2000).

- utilize no more than 30-45 percent of deep-rooted herbaceous vegetation in the active floodplain[10] and, as needed, in other critical portions of the riparian management area;
- limit streambank alteration[11] to no more than 20-25 percent; and
- limit use of woody species to no more than 30-40 percent of current year's leaders along streambanks and, as needed, in other critical portions of the riparian management area.

2. In subwatersheds that are functioning-at-risk or that have impaired function for water quality, aquatic habitat, and/or riparian and wetland vegetation and where grazing contributes to those conditions, enable recovery by managing annual livestock grazing use and disturbance as follows:
   - maintain a minimum of 6-inch to 8-inch residual stubble height of key herbaceous species on the greenline;
   - on sites with late-season grazing [12] and where willow is or should be an important component of the riparian vegetation community, maintain a minimum of 8-inch residual herbaceous stubble height
   - utilize no more than 30-35 percent of deep-rooted herbaceous vegetation in the active floodplain and, as needed, in other critical portions of the riparian management area;
   - limit streambank alteration to no more than 15-20 percent; and
   - limit use of woody species to no more than 20-30 percent of current year's leaders along streambanks and, as needed, in other critical portions of the riparian management area.

   More conservative values, within and potentially beyond the ranges described above, should be used when 1) relevant indicators (e.g., water quality, aquatic habitat, riparian vegetation) are highly departed from desired conditions and are not improving due to livestock grazing; 2) ESA-listed aquatic species and critical habitat sensitive to grazing impacts are present and conditions are not improving due to livestock grazing, with particular emphasis on high potential fish production reaches (e.g., low gradient, unconfined stream reaches); or 3) grazing-related requirements of water quality restoration plans for impaired waters (e.g., site potential shade) are not being met and conditions are not improving due to livestock grazing. Implement other applicable actions contained in ESA Recovery Plans and water quality restoration plans.

Guideline GM-4G. During allotment management planning, removing existing livestock handling or management facilities that prevent or retard attaining aquatic and riparian desired conditions should be removed, as appropriate.

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[10] Active floodplain is defined as the area bordering a stream inundated by flows at a surface elevation that is two times the maximum bankfull depth (measured at the thalweg).

[11] Streambank alteration criteria apply within 1-2 weeks of removal of livestock from each pasture.

[12] Late season grazing generally begins after sugar storage in woody vegetation is complete and leaf fall has started. Upland plant seeds have shattered and mean air temperatures begin to cool.

Guideline GM-5G. Livestock trailing, watering, loading, and other handling in riparian management areas should be avoided or minimized.

Standard GM-6S. Livestock grazing shall be managed and implemented to avoid trampling federally listed threatened or endangered fish redds.

RECREATION MANAGEMENT

Guideline RM-1G. Do not place new facilities or infrastructure within expected long-term channel migration zones if it has the potential to impact channel or floodplain function. If some facilities must occur in RMAs (e.g., road stream crossings, boat ramps, docks, and interpretive trails), locate and design them to minimize impacts on floodplains and other riparian dependent resource conditions (e.g., within geologically stable areas, avoiding major spawning sites).

Guideline RM-2G. Existing recreation facility components that are causing unacceptable impacts in riparian management areas should be removed or relocated. Site condition should be restored to improve riparian area function.

MINERALS MANAGEMENT

Guideline MM-1G. For operations in RMAs, ensure operators take all practicable measures to maintain, protect, and rehabilitate water quality and habitat for fish and wildlife and other riparian dependent resources that may be affected by the operations. Ensure operations do not retard or prevent attaining aquatic and riparian desired conditions. Exceptions to this guideline include situations where Forest Service has limited discretional authorities. In those cases, project effects should be minimized and should not prevent or retard attaining aquatic and riparian desired conditions to the extent possible within those authorities.

Guideline MM-2G. To the maximum extent possible locate and manage structures, support facilities, and roads outside riparian management areas. Where none exists, locate and manage them to minimize effects upon aquatic and riparian-dependent desired conditions. Existing roads should be maintained to minimize damage to aquatic and riparian dependent resources. When structures, support facilities, and roads are no longer required for mineral activities, they should be restored or reclaimed to achieve aquatic and riparian desired conditions.

Standard MM-3S. Avoid locating mine waste with the potential to generate hazardous material (as defined by CERCLA) within RMAs and/or areas where groundwater contamination is possible. The exception is temporary staging of waste during abandoned mine cleanup.

Guideline MM-4G. Manage mineral operations to minimize adverse effects to aquatic and riparian-dependent resources in RMAs. Require BMPs and other appropriate conservation measures to mitigate potential mine operation effects.

Standard MM-5S. Mineral activities on NFS lands shall avoid or minimize adverse effects to aquatic threatened or endangered species/populations or their designated critical habitat.

- All suction dredge mining activities in habitat for aquatic threatened or endangered species/populations or in their designated critical habitat shall be evaluated by the District Ranger to determine if the mining activity is causing or "will likely cause significant disturbance of surface resources[13]". A likelihood that a threatened or endangered species "take" (defined in Section 3[18] of the ESA of 1973 as amended) incidental to the mining activity is an example of a significant resource disturbance. Other significant disturbances that do not involve incidental take might involve effects on channel stability or stream hydraulics.
- If the District Ranger determines that placer mining operations are causing or will likely cause significant disturbance to surface resources, the District Ranger shall contact and inform the operator to seek voluntary compliance with 36 CFR 228 mining regulations and to cease operations until compliance.

WILDLAND FIRE MANAGEMENT ACTIVITIES AND FUELS MANAGEMENT WITHIN RIPARIAN MANAGEMENT AREAS

Guideline FM-1G. Locate temporary firefighting facilities (e.g., incident bases, camps, helibases, staging areas, helispots, and other centers) for incident activities outside RMAs. When no practical alternative exists, all appropriate measures to protect, maintain, restore, or enhance aquatic and riparian dependent resources should be used. If the only suitable location for such activities is within a RMA, use may be granted following review by a resource advisor and discussion with the agency administrator. The resource advisor will work the incident management team to prescribe the location, use conditions, and rehabilitation requirements. Use an interdisciplinary team to predetermine suitable incident base and helibase locations.

Guideline FM-2G. Aerial application of chemical retardant, foam, or other fire chemicals is prohibited within 300 feet (slope distance) of perennial and intermittent waterways. Waterways are defined as any body of water (including lakes, rivers, streams, and ponds) whether or not it contains aquatic life except in cases where human life or public safety is threatened and chemical use could be reasonably expected to alleviate that threat. This includes open water that may not be mapped as such on avoidance area maps and intermittent streams that are running or holding surface water at the time of retardant use.

Standard FM-3S. Portable pump set-ups shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Vehicles shall be parked in locations that avoid entry of spilled fuel into streams. When drafting, pumps shall be screened at drafting sites to prevent entrainment of aquatic species, screen area shall be

[13] The phrase ''will likely cause significant disturbance of surface resources'' means that, based on past experience, direct evidence, or sound scientific projection, the District Ranger reasonably expects that the proposed operations would result in impacts to NFS lands and resources which more probably than not need to be avoided or ameliorated by means such as reclamation, bonding, timing restrictions, and other mitigation measures to minimize adverse environmental impacts on NFS resources

sized to prevent impingement on the screens, and shall have one-way valves to prevent back-flow into streams. Use NMFS-approved screening criteria where listed fish or critical habitat are present.

Guideline FM-4G. Locate and configure firelines to minimize sedimentation to waterbodies, capture of overland and streamflows, and development of unauthorized roads and trails. Restore firelines following suppression or prescribed fire activities.

Standard FM-5S. To minimize soil damage when chipping fuels within riparian management areas, chip bed depths on dry soils shall be limited to 7.5 cm or less (Busse et al. 2005).

Guideline FM-6G. Disturbed areas, such as firelines, drop-points, camps, roads, and trails, should be restored by actions such as scattering slash piles, replacing logs and boulders, scarifying soils, recontouring terrain, and reseeding with native species.

Guideline FM-7G. Pumping directly from a stream channel should be avoided if chemical products are to be injected directly into the system. When chemicals are used, pumping should be conducted from a fold-a-tank that is located outside the riparian area.

Guideline FM-8G. Minimum impact suppression tactics (MIST) should be utilized in sensitive areas, such as designated wilderness areas, designated wild and scenic river corridors, research natural areas, botanical areas, riparian management areas, cultural and historic sites, developed recreation areas, special use permit areas that have structures, and historic and recreational trails. MIST techniques should also be used for post fire restoration activities.

Guideline FM-9G. Prescribed burn direct ignition in RMAs should not be used unless site/project scale effects analysis demonstrates that it would not retard attaining aquatic and riparian desired conditions.

Standard FM-10S. Ensure prescribed burn projects contribute to and do not retard the attainment of the aquatic and riparian desired conditions.

Guideline FM-11G. Chemicals or retardant should not be used for suppression or mop-up within riparian areas.

Standard FM-12S. Pumps and charged hoses shall not be back flushed into stream channels, wetlands, or surface water.

LANDS AND SPECIAL USES, INCLUDING HYDROPOWER IN RIPARIAN MANAGEMENT AREAS

Standard LH-1S. Authorizations for all new and existing special uses, including, but not limited to water diversion or transmission facilities (e.g., pipelines and ditches), energy transmission lines, roads, hydroelectric, and other surface water development proposals, shall result in the re-establishment, restoration, or mitigation of habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, water and other riparian dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity, water quality, and integrity and complexity of riparian and aquatic habitat.

Standard LH-2S. New support facilities shall be located outside of riparian management areas. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, and transmission lines) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation or enhancement measures.

Guideline LH-3G. If existing support facilities are located within the riparian management areas, they should be operated and maintained to restore or enhance aquatic and riparian dependent resources. At time of permit re-issuance, consider removing support facilities, where practical.

Guideline LH-4G. Land exchanges should avoid the disposition of occupied habitat of threatened, endangered, candidate, proposed, or sensitive species.

WATERSHED (FORESTWIDE)

Standard WM-1S. When watershed function[14] desired conditions are being achieved and watersheds are functioning properly[15], projects shall maintain[16] those conditions. When watershed function desired conditions are not yet achieved or watersheds have impaired function or are functioning-at-risk and to the degree that project activities would contribute to those conditions, projects shall restore[17] or not retard attainment[18] of desired conditions. Short-term[19] adverse effects from project activities may occur when they support or do not diminish long-term[20] recovery of watershed function desired conditions and federally listed species. Exceptions to this standard include situations where Forest Service authorities are limited (Alaska National Interest Lands Conservation Act {ANILCA}, 1872 Mining law, valid state water right, etc.). In those cases, project effects shall be minimized and not retard attainment of desired conditions for watershed function, to the extent possible within

[14] Per Revised Land Management Plan Watershed Function desired conditions (watershed function, hydrologic, riparian, wetland, stream channel, groundwater dependent ecosystem, and aquatic habitat).

[2] The Watershed Condition Framework categories of terminology for "functioning properly", "functioning-at-risk", and impaired function are equivalent to the "functioning appropriately" "functioning-at-risk" and "functioning at unacceptable risk" categories within the matrix of pathways and indicators (USFWS 1998), and to the respectively equivalent to "properly functioning" or "at risk" or "not properly functioning" categories within the matrix of pathways and indicators used by NMFS (1996).

[16] See glossary for definitions of "maintain" and "degrade".

[17] See glossary for definitions of "restore".

[18] See glossary for definitions of "retard attainment".

[19] See glossary for definition of "short-term adverse effects" See the Implementation Plan for application of the definition.

[20] See glossary for definition of "long-term recovery". See the Implementation Plan for application of the definition.

Forest Service authorities. Use ARCS Attachment 2 to assist in determining compliance with this standard.

Standard WM-2S. All projects shall be implemented in accordance with Best Management Practices, as described in National and Regional Technical Guides.

KEY WATERSHED AND SUBWATERSHEDS WITH ESA CRITICAL HABITAT FOR AQUATIC SPECIES (FORESTWIDE)

Standard KW-1S. In Key Watersheds or subwatersheds with ESA critical habitat for aquatic species or subwatersheds containing listed aquatic species that are functioning properly[21] there shall be no net increase (1 mile of road-related risk reduction for every new mile of road construction), where they are functioning-at-risk[22], there shall be a net decrease (1.5 miles of road-related risk reduction for every new mile of road construction), and where they are impaired function[23], there shall be a net decrease (2.0 miles of road-related risk reduction for every new mile of road construction) in system roads that affect hydrologic function. Priority for road-related risk reduction shall be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems. Road-related risk reduction will occur prior to new road construction unless logistical restrictions require post-construction risk reduction. This standard shall apply to the affected subwatershed when new system road construction is proposed in that subwatershed, and shall not be offset by reductions in open-road densities in other subwatersheds.

Standard KW-2S. In Key Watersheds and subwatersheds with ESA critical habitat for aquatic species or subwatersheds containing listed aquatic species, hydroelectric and other surface water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.

Standard KW-3S. In Key Watersheds and in subwatersheds with ESA critical habitat for aquatic species or subwatersheds containing listed aquatic species, new hydroelectric facilities and water developments shall not be located in a Key Watershed unless it can be demonstrated that there are minimal risks and/or no adverse effects to the fish and water resources for which the Key Watershed was established.

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[21] "Functioning properly", "functioning-at-risk", and "impaired function" for the roads and trails indicator of Watershed Condition Framework are defined in Watershed Condition Framework Technical Guide, USDA Forest Service, 2011b. Local inventory, assessment and monitoring data and information can be used to refine initial classifications made per WCF.

[22] "Functioning properly", "functioning-at-risk", and "impaired function" for the roads and trails indicator of Watershed Condition Framework are defined in Watershed Condition Framework Technical Guide, USDA Forest Service, 2011b

Watershed restoration (Forestwide)

Guideline RE-1G. Watershed restoration projects should be designed to utilize or emulate natural ecological processes to the extent practicable, for meeting and maintaining restoration objectives.

Guideline RE-2G. Watershed restoration projects should be designed to minimize the need for long-term maintenance.

Standard RE-3S. Except where Forest Service authorizes are limited, mitigation or planned restoration shall not be used as a substitute for preventing long-term watershed or habitat degradation.

Standard RE-4S. Hydrologic connectivity and sediment delivery from roads and trails shall be minimized. This includes roads, or road segments, whether inside and outside of riparian management areas (RMAs), that deliver sediment to streams.

Standard RE-5S. Minimize adverse effects to ESA listed and proposed and their designated and proposed critical habitat in accordance with Forest Service authorities. Management activities shall not retard recovery[24] of listed and proposed species and their designated and proposed critical habitat in the long-term in accordance with Forest Service authorities. Federally listed and proposed species and their designated and proposed critical habitats shall be managed in accordance with their recovery plans, in accordance with Forest Service authorities.

Invasive Species (Forestwide)

Guideline IS-1G. Avoid cross contamination between streams, reservoirs and lakes from pumps, suction and dipping devices or any other equipment. Avoid dumping water directly from one stream or lake into another. Disinfect water storage and conveyance equipment including sampling equipment, water tenders, pumps, engines and aircraft prior to use on Forest.

Management Areas

- 36 CFR 219.19 (2012) (d) **Management areas or geographic areas**. Every plan must have management areas or geographic areas or both. The plan may identify designated or recommended designated areas as management areas or geographic areas.

- 36 CFR 219.19 (2012) **Definitions. Management areas.** A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous.

[24] See glossary in the Plan for definitions of "retard attainment".

Management areas are spatially distinct areas with a unique set of plan components. The management areas range along a continuum from little development by humans in MA 1A to extensive human development in MA 6. The types of uses and desired settings define the land use that would occur in them under the revised forest plans. They occur across districts, mountain ranges, and ecosystems but have commonalities that make their overarching land uses similar.

Riparian Management Areas

In the Blue Mountains Forest Plan, there is a separate management area identified for riparian areas, emphasizing their importance on the landscape; referred to in the plan as Riparian Management Areas. RMAs are portions of a watershed where riparian–dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines.

RMAs include portions of watersheds where water quality and aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies. RMAs include traditional riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the streams' water, sediment, woody debris, and nutrient delivery system. RMAs are used to protect, maintain and restore the riparian structure and function of intermittent and perennial streams, confer benefits to aquatic and riparian-dependent plant and animal species, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, and provide for greater connectivity within and between watersheds for both riparian and upland species. They are also critically important to maintaining and restoring water quality.

RMAs are used as the primary framework (coarse filter) that provides for ecosystem diversity by conserving biophysical processes at the landscape and watershed scales. RMAs provide travel and dispersal corridors for many riparian-dependent animals and plants and provide connectivity between geographically significant areas for both riparian and upland species. Management activities within RMAs protect, maintain or enhance existing functional conditions or restore degraded conditions for aquatic and riparian-dependent species.

RMAs generally parallel the stream network and include areas necessary for maintaining hydrologic, geomorphic, and ecologic processes that influence riparian and aquatic systems. Unstable and potentially unstable areas in headwaters and along streams are primary source areas for coarse wood, fine and coarse particulate organic matter, and sediment (FEMAT 1993). RMAs occur at the margins of standing and flowing water, intermittent stream channels, and ephemeral ponds, springs, and wetlands.

Management of RMAs focuses on ecological processes and conditions within and contributing to the value of these areas. Management activities within them contribute to moving toward or meeting or maintaining desired conditions. The following RMA widths were identified in these Forest Plans. The scientific basis for them was originally provided in FEMAT (1993) and later supported by a review by Everest and Reeves (2007).

Fish-bearing streams - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest. In degraded or incised streams, the RMA should extend from the edge of the active channel to the outer extent of the former floodplain. Riparian management area widths along fish-bearing streams will not be less than described here.

Permanently flowing non-fish-bearing streams - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest. In degraded or incised streams, the RMA should extend from the edge of the active channel to the outer extent of the former floodplain.

Constructed ponds and reservoirs, and wetlands greater than 1 acre – RMAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.

Lakes and natural ponds - RMAs consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.

Seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre, and unstable and potentially unstable areas - This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RMAs will include:

- The extent of unstable and potentially unstable areas (including earthflows).
- The stream channel and extend to the top of the inner gorge, or in incised streams, to the edge of the former floodplain.
- The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.
- Intermittent streams are defined as any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes

what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Including intermittent streams, springs, and wetlands within RMAs is important for full implementation of the ARCS. Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. Fish-bearing intermittent streams are distinguished from non-fish-bearing intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams, or travel routes for fish emigrating from lakes. In these instances, the guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.

Note: Riparian Management Area widths may only be adjusted based on a watershed analysis.

Suitability of Areas

Definition:

- 36 CFR 219.3 (1982) **Suitability**: The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

Specific lands within a plan area will be identified as suitable for various multiple uses or activities based on the desired conditions applicable to those lands. Suitability describes the appropriateness of applying certain resource management practices (uses) to a particular area of land. A unit of land may be suitable for a variety of individual or combined uses.

The plan will also identify lands within the plan area as not suitable for uses that are not compatible with desired conditions for those lands. The suitability of lands need not be identified for every use or activity. Suitability identifications may be made after consideration of historic uses and of issues that have arisen in the planning process. Every plan must identify those lands that are not suitable for timber production (36 CFR 219.11). For example, a project with the purpose of timber production (see glossary) may only occur in an area identified as suitable for timber production [16 U.S.C. 1604(k)] (see Suitability discussion on page 53). The documentation for the project should confirm the project area meets the suitability requirements.

Except for projects with a purpose of timber production, a project or activity can be consistent with plan suitability determinations in either of two ways:

2. The project or activity is a use identified in the plan as suitable for the location where the project or activity is to occur; or

3. The project or activity is not a use identified in the plan as suitable for the location (the plan is silent on the use or the plan identifies the use as not suitable), but the responsible official determines that the use is appropriate for that location's desired conditions and objectives.

An area may be identified as generally suitable for uses that are compatible with desired conditions and objectives for that area. An area may be identified as generally not suitable for uses that are not compatible with desired conditions and objectives for that area. Identification of an area as generally suitable or generally not suitable for a use is guidance for project and activity decision making and not a commitment nor a final decision approving projects and activities.

Uses or activities in specific areas are approved through project and activity decision making.

Suitable uses are identified for each management areas in the forest plans to help further refine suitable uses and guide management. Suitable activities or uses in Riparian Management Areas maybe adjusted based on watershed analysis.

Suitability for Riparian Management Areas

Riparian Management Areas are **generally unsuitable** for:

- New Road or Trail Construction
- Salable mineral activities, such as gravel and sand
- Energy Development (e.g. wind farms, utility corridors, pipelines, etc.

Riparian Management Areas are **unsuitable** for:

- Regularly scheduled timber production (regularly scheduled timber harvest on suitable lands); since they are not part of our timber suitability landbase.
- Grazing management that degrades aquatic habitat conditions or impedes attainment of aquatic and riparian-dependent resources

Riparian Management Areas are **generally suitable** for:

- Silvicultural treatments necessary to maintain, enhance or restore conditions for aquatic and riparian resources. When conducted, these activities shall avoid or minimize adverse effects to aquatic and riparian resources and not degrade or retard attainment of aquatic and riparian-dependent resources
- Timber Harvest and Mechanical fuel treatment may be allowed under certain circumstance to meet Riparian Management Area DCs
- Grazing management that does not degrade or retard attainment of aquatic and riparian-dependent resources
- Motor Vehicle use consistent with 36 CFR 212 of the Travel Management Rule

Monitoring

§ 219.12 Monitoring. (a) Plan monitoring program.

(1) The responsible official shall develop a monitoring program for the plan area and include it in the plan. Monitoring information should enable the responsible official to determine if a change in plan components or other plan content that guide management of resources on the plan area may be needed. […]

(2) The plan monitoring program sets out the plan monitoring questions and associated indicators. Monitoring questions and associated indicators must be designed to inform the management of resources on the plan area, including by testing relevant assumptions, tracking relevant changes, and measuring management effectiveness and progress toward achieving or maintaining the plan's desired conditions or objectives. Questions and indicators should be based on one or more desired conditions, objectives, or other plan components in the plan, but not every plan component needs to have a corresponding monitoring question.

(3) The plan monitoring program should be coordinated and integrated with relevant broader-scale monitoring strategies (paragraph (b) of this section) to ensure that monitoring is complementary and efficient, and that information is gathered at scales appropriate to the monitoring questions. For more information, see the 2012 Planning Rule.

Monitoring and evaluation consists of key element monitoring that will occur as implementation of the forest plan progresses (i.e., future site-specific actions). Monitoring is part of an adaptive management process that measures the performance of plan implementation against the goals, desired conditions and objectives to which it aspires. It also evaluates whether implementation of standards and guidelines are producing the desired results.

Variation in achieving objectives may occur during the life of the plans because of changes in environmental conditions, available budgets, and other factors. Influences on objectives include recent trends, past experiences, anticipated staffing levels, and budget projections. Objectives are projections of Forest Service activities and program outcomes that are measurable and time specific. Like goals and desired conditions, objectives are not commitments or final decisions approving projects or activities. They are an effort by the Forest Service to share with the public how progress toward achieving or maintaining the desired conditions during the life of the plans will be measured. The objectives stated are only a partial list of the management activities expected to be accomplished to contribute to maintaining or achieving desired conditions.

Objectives are based on ecological needs, community capacity, and expected funding, including budgets, partnerships, and cooperative agreements. The actual accomplishments will be dependent on actual funding, staffing levels, and local infrastructure. The objectives are not intended to limit or guarantee the amount of work that will be accomplished. More work may be accomplished if additional infrastructure or funding, such as increased budget allocations, partnerships, or other external sources, becomes available. Less work could occur if funding is less than expected, additional infrastructure is not constructed, or existing infrastructure declines and becomes unusable.

Objectives are expected to be accomplished during the first decade of the plan period, unless otherwise indicated within the objective statement. The objectives reflect the activities and program outcomes necessary to achieve or maintain desired conditions.

7. Watershed Analysis

Watershed analysis is an essential component of the ARCS. The content of this section is included in Blue Mountain Forest plans as other plan content.

Background

Assessments, which covered the three Blue Mountain Forests were conducted before the Forest plans were revised to identify the need to change plan direction and to inform the development of plan components. This section pertains to watershed analysis, which is conducted at finer spatial scales (generally subbasins to subwatersheds, 8-12 digit HUs) as historically used to inform plan implementation, after they have been developed, amended, or revised.

Through implementation of the existing aquatic strategies in the 1990s and early 2000s, watershed analyses have been completed for the majority of NFS lands within the ARCS area. Consequently, future work will largely focus on efficiently updating, as needed, a portion of those existing analyses to better reflect current watershed conditions and trends, new issues (e.g., climate change, invasive species), latest science and policy, and current opportunities.

Purpose

Watershed analysis is an interdisciplinary analysis of the status and trends of watershed and aquatic ecosystem conditions, including key State-designated beneficial uses of water (e.g., municipal water supply), and the hydrologic, geomorphic, and biological processes that strongly influence them. This information serves as a foundation for plan implementation through the development of strategic and integrated programs and projects that protect and restore aquatic resources, while enabling informed and sustainable resource use and management. These analyses combined with monitoring and evaluation (Section 9), provide the context and foundation to adaptively execute the other components of the ARCS, including management of RMAs and Key Watersheds, implementation of Watershed Restoration, and compliance with plan components.

Watershed analysis is intended to guide plan implementation by providing decision-makers and others: 1) information to identify activities that would maintain watershed and aquatic and riparian ecological conditions or move them towards desired conditions; and 2) the context for developing projects and evaluating their consistency, via the NEPA process, with plan direction (i.e., desired conditions, objectives, standards, and guidelines associated with watershed and aquatic resources). This includes ensuring that management activities in Key Watersheds and RMAs maintain, restore, or enhance aquatic and riparian resources.

Through identification of actions needed to avoid or minimize adverse effects and/or restore ecosystem conditions and processes, watershed analysis is also intended to enable protection and recovery of listed species and their habitats and to facilitate efficient project-level conferencing and consulting under Section 7 of the Endangered Species Act. Similarly, it should enable protection and restoration of water quality and the full range of beneficial uses of water identified by the States and Tribes under the Clean Water Act.

Watersheds to be Analyzed

The Blue Mountain Forests estimated the number of new or updated watershed analyses expected to be completed during the life of the Forest plans and identified a set of potential watersheds for which this work will be a priority. Criteria for selecting potential watersheds for analysis included: (1) Key Watersheds; (2) watersheds that have been identified as Priority Watersheds during the life of the Plan; (3) watersheds that support listed species or contains designated critical habitat; and (4) watersheds wherein management activities are likely to occur that may substantially affect aquatic resources (e.g., due to their inherent nature, location, timing or scale).

Watershed analyses should generally be conducted or updated prior to developing and implementing Watershed Restoration Action Plans for Priority Watersheds.
In addition, watershed analyses shall be conducted or updated prior to:

- proposing changes to RMA widths
- timber salvage or construction of facilities in RMAs
- construction of permanent system roads in RMAs

Line Officer Role

The desired outcome is an efficient, effective analysis that provides a better understanding of watershed structure and function and a set of recommendations that help inform future management actions within and around the watershed. To achieve this goal, line officers should guide analysis teams throughout the analysis process, ensuring that the analysis focuses on the most critical issues and questions and that the scope, type and level of analysis is aligned with management needs and available financial resources and staff. This is critical to avoiding common pitfalls observed in previous analyses, which included unconstrained scope and level of detail.

Analysis Process

The watershed analysis process, as described in the Federal guide to watershed analysis *(Regional Ecosystem Office, 1995)*, includes 6 steps to be conducted in an interdisciplinary process: 1) characterizing the study watershed; 2) identifying important water and aquatic resources and key management issues and questions associated with them; 3) describing current resource conditions and trends and the dominant biophysical processes (natural and human-caused) responsible for them; 4) comparing and contrasting those conditions with applicable reference conditions; 5) synthesizing and interpreting that information; and 6) identifying opportunities and making management recommendations to maintain or restore watershed and aquatic resources when those conditions are consistent with or trending towards desired conditions or otherwise to improve those resource conditions. This process involves characterizing the study watershed, describing past and current conditions, assessing trends, synthesizing information, and making management recommendations. The result is a better understanding of watershed structure and function and a set of recommendations that help inform future management actions within and around the watershed.

The watershed (10-digit HU) is the primary scale of the analysis. However, since relevant issues, ecological conditions, and dominant biophysical processes often occur at both broader and finer scales, components of the analysis may need to be conducted at a subbasin scale, while others may need to be addressed at a subwatershed or finer scale. Still others (e.g., habitat connectivity between and within watersheds) may need to be evaluated at multiple scales. The challenge is to efficiently analyze the interaction of multiple processes operating at multiple spatial and temporal scales and incorporate relevant findings into a concrete watershed conservation and management strategy.

The topics to be covered in a watershed analysis generally include: 1) hydrologic and geomorphic processes; 2) vegetation; 3) disturbance regimes; 4) transportation systems; 5) water quality; 6) aquatic and riparian species and habitats; and 7) human uses.

Updating Existing Watershed Analyses

As previously described, most future work will involve updating existing analyses rather than conducting entirely new ones. The process for updates is similar to the analysis process described above, except that updates should be narrowly focused on refreshing, refining or augmenting only those critical components of the existing documents that do not reasonably address current issues and questions, adequately characterize current resource conditions and trends, align with current science and policy, or reflect contemporary management opportunities.

Line officers should define the scope of these updates and the financial and staff resources available to support them, after considering the recommendations of an interdisciplinary team that has critically reviewed the existing analyses.

General Products

The products of a watershed analysis generally include all or a subset of the following, depending on the scope of the analysis:

- a summary of the current status and trajectory of watershed conditions, aquatic and riparian-dependent resources and their habitat, water quality, and key State-designated beneficial uses of water

- a description of the key historic and ongoing processes (natural and human-caused) responsible for those conditions and trends
- an assessment of the status and trends of the watershed with respect to general Forest-wide desired conditions (DCs) at applicable scales (subbasin and/or watershed) and any specific DCs for Key Watersheds and/or Riparian Management Areas (RMAs)
- any recommended adjustments to the default, forest-wide widths for RMAs as necessary
- a recommendation for retaining or changing the status of the watershed with respect to the Key Watershed network (e.g., adding or removing the watershed from the network)
- identification, validation or refinement of restoration actions: including instream, aquatic and terrestrial vegetation treatments, road related treatments.
- any issues that should be considered when designing projects to comply with Standards and/or Guidelines for the analysis watershed(s)
- any recommended project design criteria that might be applicable in the analysis watershed(s)
- specific opportunities for managing, protecting, and restoring the watershed and its key resource values. This includes identification of areas within the watershed that are particularly important and activities that could be taken or avoided to protect and restore watershed conditions while achieving other socioeconomic objectives
- a strategic framework for implementing restoration opportunities. This includes a ranked list of Candidate Priority Subwatersheds (12-digit HU) to consider restoring via the FS National Watershed Condition Framework (WCF) process, the general type and scope of critical restoration treatments, their general location and priority, and any major considerations for timing/completion of restoration work
- a completed Watershed Restoration Action Plan (WRAP) for WCF Priority Subwatersheds per the national template (optional)
- significant information gaps and the inventories, monitoring, and/or analyses needed to address those gaps, and their relative priority
- a list of key monitoring questions and indicators.

These products should be informed by and aligned with the major goals, objectives, strategies, and tactics included in other relevant restoration/recovery plans (e.g., ESA-recovery plans, State restoration plans for impaired waters).

Specific map and tabular products may include all or a subset of the following, depending on the scope of the analysis:

- perennial and intermittent streams, fish habitats (including key spawning and rearing areas, critical habitat, etc.), and any major barriers to fish passage
- other special aquatic habitats (side channels, ponds, associated wetlands, etc.) of particular importance

- groundwater-dependent ecosystems (including springs) and important groundwater recharge zones
- key beneficial uses of water
- major water rights and uses
- the quality, quantity, and timing of streamflows and areas and processes that strongly influence them
- any water-quality limited stream segments
- available stream and water quality inventory and monitoring results, including those from PIBO1, applicable stream temperature monitoring and assessment programs, the Regional stream survey program, and other relevant programs
- Key and/or Priority Watersheds in the analysis area
- RMAs, including unstable areas
- key geomorphic features and processes strongly influencing watershed conditions and resources
- current and historic forest and rangeland vegetative conditions
- wildfire risks relevant to aquatic and riparian resources
- potential impacts/risks that the road network poses to watershed conditions and aquatic resources
- known and high-risk sites for aquatic and riparian invasive species
- projected climatic changes (e.g., streamflows, stream temperatures, aquatic biota, vegetative conditions) relevant to aquatic resources
- a listing of priority restoration treatments, including the location or general area and relative priority and any major considerations for timing/completion of restoration work.

Relationship with Project and Watershed Planning and Landscape Analysis

Watershed analysis is best conducted separate from project-level planning and the NEPA process. Its results are used to identify projects ripe for implementation and its analysis can be used to prepare NEPA analyses, particularly Purpose and Need Statements and Existing Conditions. A watershed analysis more thoroughly informs decisions. It may also be appropriate for new analyses or significant updates, when a unit is contemplating complex projects covering a wide range of activities over large areas and multiple years, a new watershed analysis or a significant update to an existing analysis should be considered. Sometimes contemplated large scale vegetation management projects spanning multiple watersheds require an analysis that helps to understand resources and their interaction with a broader perspective. The watershed analysis approach described here can be applied at broader scales if needed.

Where feasible, watershed analysis should inform the watershed restoration process, as specified in Section 8. Specifically, these analyses can guide selection of Priority Watersheds and development of Watershed Restoration Action Plans via the Watershed Condition Framework process (Figure 8).

Documentation

Watershed analyses should be a concise synthesis of key information about resource conditions and trends and the recommended management strategies and actions to address them. Line officers should define their scope and review and approve final products. These analyses should be kept in the record and be readily available for use. Supporting geospatial data should also be retained as part of the record. Watershed analyses are not federal actions leading to a decision and do not require NEPA analysis and documentation.

Analysis Resources

Many resources, as described below, are available to support watershed analysis.

Existing Analyses

Much of the watershed analysis process involves the integration and synthesis of existing information. Therefore, identification and review of existing analyses is a critical step in the process. Similar to the assessment phase of plan development or revision (Section 6), information from the following documents should be reviewed and synthesized during the analysis process and be used to guide other components of the analysis, as appropriate given the scope of the analysis: 1) results of Step A (Assessment) of the National Watershed Condition Framework, 2) existing watershed analyses, 3) status reviews/assessments and recovery plans for threatened, endangered, or sensitive species, 4) State assessments and management plans associated with water quantity and quality, 5) results of broad-scale status and trend monitoring programs (e.g., PIBO), 6) transportation analyses, and 7) climate change vulnerability assessments and adaptation strategies. In addition, relevant broad-scale environmental analyses for the area may be useful.

Watershed analyses are intended to address issues at finer scales, primarily at the watershed scale. However, some of the existing information may only provide context for how conditions in a subbasin or watershed compare with other subbasins or watersheds. Other existing data and reports, however, may provide information about specific conditions within the analysis watershed. Some other sources may do both.

PACFISH (1995) and INFISH (1995) require watershed analysis prior to management actions, including timber harvest and road construction, in Priority Watersheds or riparian habitat conservation areas (RHCAs). Watershed analysis is required prior to salvage logging within RHCAs or adjusting the widths of RHCA boundaries. The watershed analyses (WA) that have been completed since implementation of PACFISH and INFISH are displayed in Attachment A.

Attachment A, Table 5 lists the 47 watershed analyses that have been completed by the Malheur, Umatilla, and Wallowa-Whitman National Forests between 1994 and 2006 covering 56 individual watersheds (HUC10). Figure 10 displays watersheds with completed analyses and the year each analysis was completed. Not shown in Attachment A, Table 5 or Figure 10 are watersheds with completed Watershed Action Plans (e.g. Camp Creek – Middle Fork John Day River, 2008).

Completed watershed analyses encompass 3.6 million acres of 5.5 million acres of NFS lands in the Blue Mountains. Of approximately 1.8 million acres, or 33% of the area of NFS lands with no completed watershed analysis, 859,500 acres (47%) are within wilderness or inventoried roadless areas. After accounting for wilderness and roadless areas, 83% of NFS acres have completed watershed analyses.

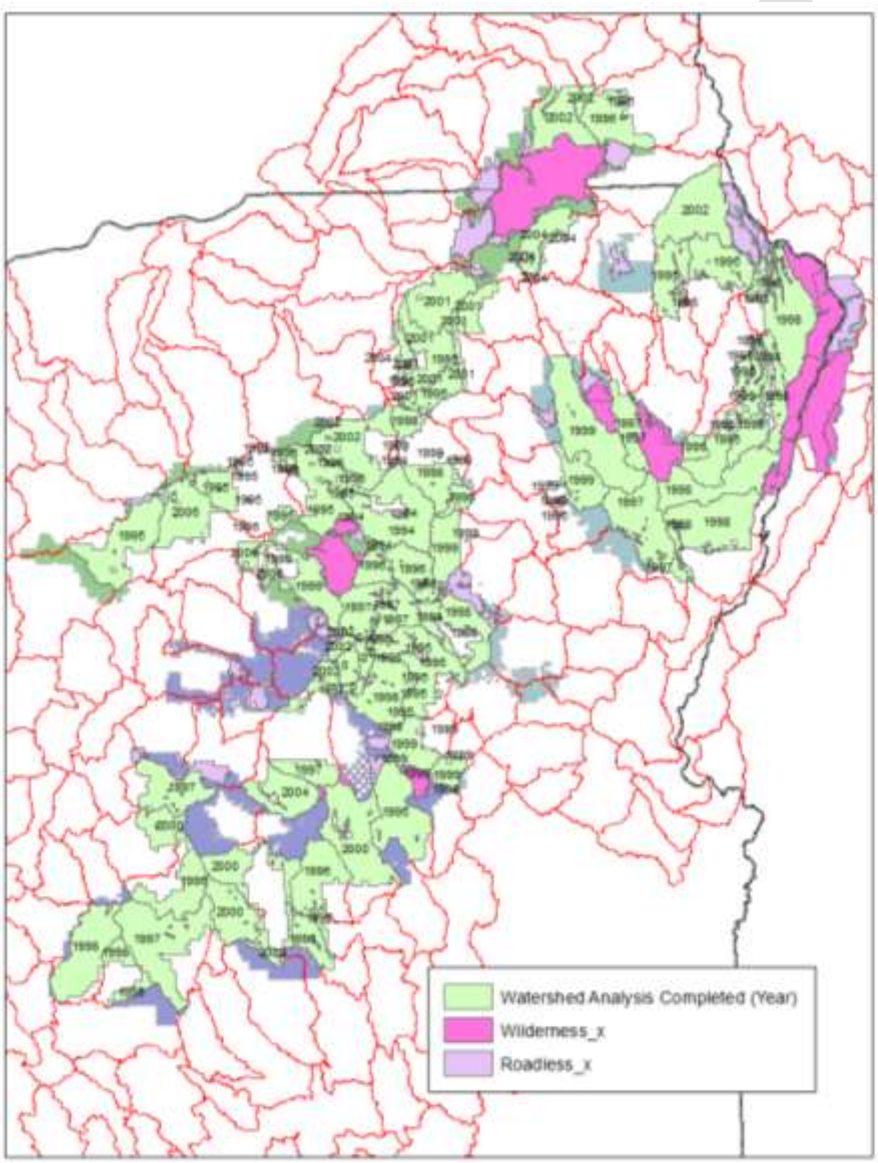

Figure 10. Map showing completed watershed analyses (green) on National Forest System lands in the Blue Mountains. Numbers are year analysis was completed. Wilderness and inventoried roadless areas outside of watersheds with completed watershed analysis are displayed in magenta.

Parts of 64 watersheds in the Blue Mountains are without a completed watershed analysis. Of these, 23 have less than 10,000 acres of NFS lands. Of the 41 watersheds with more than 10,000 NFS acres, 16 have 50% or more of NFS area in wilderness or roadless areas. Including the Hells Canyon National Recreation Area, only 17% of NFS lands in the Blue

Mountains within existing roadless or wilderness areas have been the subject of a watershed analysis.

In addition to the listed watershed analyses, at least four broad-scale analyses of watershed and aquatic/riparian habitat conditions have been conducted for areas encompassing watersheds on NFS lands in the Blue Mountains. The Pacific Northwest Region (Region 6) assessed basin-scale watershed and habitat conditions in identifying region-wide restoration priorities (Heller et al. 2002, USDA-FS 2005). Separate analyses were conducted by individual forests, to assess watershed, riparian, and aquatic habitat conditions and establish priorities for restoration (Malheur N.F. 2005, Umatilla N.F. 2002, Wallowa-Whitman N.F. 2002). Watershed, riparian, and habitat conditions were re-assessed, along with population status and distribution of four selected surrogate species (bull trout, steelhead, chinook salmon and, redband trout) in order to determine watersheds with the greatest restoration potential and best remaining aquatic habitat conditions for use in naming Key Watersheds and prioritizing watersheds for restoration. Most recently, watershed conditions were assessed on each forest using the nationally mandated watershed condition framework, or WCF (USDA-FS 2011).

ANALYSIS GUIDES

Existing guidebooks, such as Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis (Regional Ecosystem Office, 1995), provide a logical, structured and organized approach to conducting watershed analyses. Analysis teams are thus encouraged to use relevant components of this guidebook to direct their work. Components of these guidebooks that are beyond the scope or level of detail decided by the line officer should be disregarded.

DATASETS AND ANALYSIS TOOLS

Numerous datasets, models, and other analysis tools are available to assist in conducting watershed analysis. Each has different capabilities and strengths and limitations, which need to be critically evaluated prior to their application. Use of these tools should be focused on filling important information gaps needed to address the key management questions identified early in the analysis process.

Available models can simulate a variety of watershed processes, including surface erosion and mass wasting, stream shade and/or heat loading to streams, large woody debris recruitment, and fluvial and floodplain processes. In addition, existing models can be used to characterize a variety of road-related impacts to watersheds and aquatic ecosystems.

The following datasets are generally available across the Region and should be considered for use in the analysis, as needed.

- National Hydrography Dataset and Watershed Boundary Dataset
- Regional fish distribution and fish passage databases
- USGS streamflow monitoring
- streamflow modeling (e.g., Variable Infiltration Capacity model)
- Region 6 Physical and Biological Stream Survey data and reports

- historic surveys and photos
- National Watershed Condition Assessment
- PIBO data and analyses
- stream temperature monitoring and modeling (e.g., NorWeST products)
- State and Federal habitat and population monitoring programs
- Recovery plans and status reviews/assessments
- State and Federal water quality monitoring
- State lists of water-quality limited streams (303-d list)
- Water Rights and Uses database
- Surface Water Diversion Database
- Terrestrial Ecological Unit Inventory
- Topographic data (e.g., digital elevation models)
- Aerial photographs
- Existing and potential vegetation
- Fire Regime Condition Class maps
- Forest transportation systems
- rangeland condition assessments and monitoring
- Regional aquatic and riparian invasive species database
- Climate change datasets (snow, flow regimes, stream temperatures, soil-drought)

Typically, these data sources can and should be complemented with local information for the analysis area (e.g., localized road condition inventory).

The products of broad-scale status and trend monitoring (Section 12), in particular the PIBO Datasets, can be used to inform analysis of specific watersheds. For example, as a starting point for watershed analysis, analysis teams can consider how upslope and in-channel conditions and trends for a particular watershed fit within the distribution of conditions and trends across all reference (least disturbed) and managed watersheds on Federal lands throughout the Pacific Northwest and Interior Columbia River Basin. Data from reference sites can be used to characterize the range of potential "reference conditions" and assess how existing conditions in a particular watershed compare with them (**Error! Reference source not found.**11).

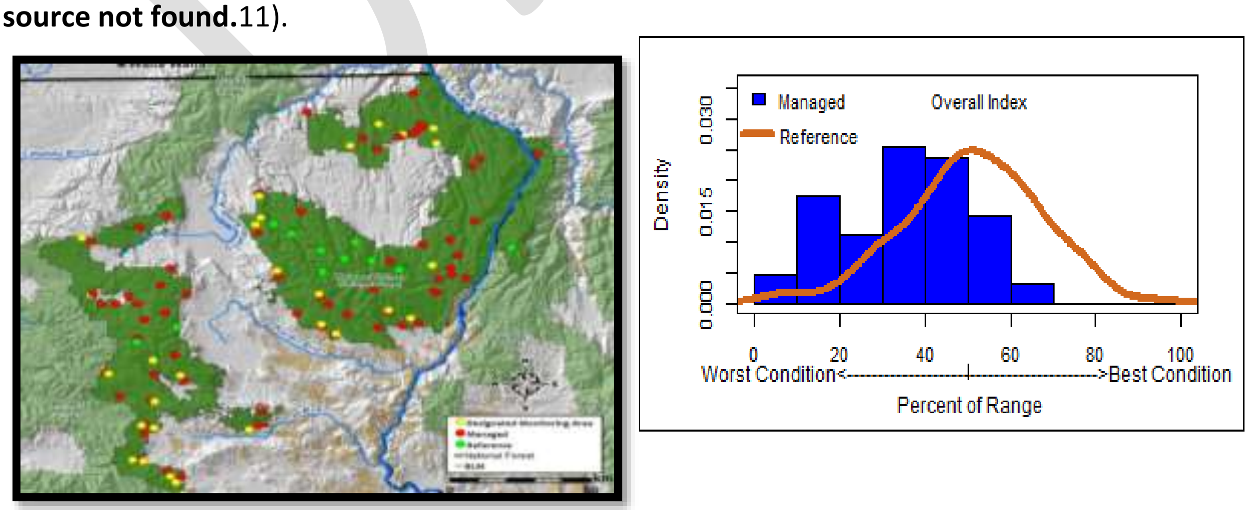

Figure 11. The distribution of stream habitat condition index scores for sites on the Wallowa-Whitman National Forest. Distributions are provided for streams in managed watersheds (blue histogram) and for expected reference conditions determined from data from minimally-managed watersheds (brown line). The habitat index is an integrated score comprised of scores from multiple habitat parameters, such as substrate composition, fine sediment in pools, large wood frequency, percent pool habitat, and macroinvertebrate community composition (Al-

This, together with the watershed-specific information described below, can enable analysis teams to more completely and accurately assess watershed and aquatic habitat conditions, their likely trajectories, the reasons those conditions exist (e.g., natural disturbance or human impacts), what actions might be warranted in the watershed, and generally how and where they should be implemented. This two-tiered approach, involving broad-scale status and trend assessment and monitoring across many watersheds to identify spatial and temporal patterns, coupled with more detailed, process-based analysis of specific watersheds to identify the causes of these patterns and management needs and opportunities, is consistent with the recommendations of Lisle et al. (2014).

It is important to recognize that while "reference conditions" are quite useful in describing potential environmental conditions and providing a tool for diagnosing current status and trends, they may not always equate to desired conditions. First, while they may characterize the "best available" and perhaps the "best attainable" conditions based on current data and information, they do not necessarily represent "natural" or "pristine" conditions because all watersheds have been impacted by human activities to some degree (e.g., fire suppression). As such, our understanding of true "natural conditions" is limited and may not necessarily represent natural conditions in space and in time, or those conditions may not always be "desirable". Moreover, even if these natural conditions were fully understood, those conditions may not always be "desirable". In addition, these conditions need to be assessed in the context of the species, issue, or process of interest to holistically understand whether deviation from reference condition is ecologically meaningful. For example, high levels of fine sediments may adversely affect developing salmonid eggs, but may support spawning lamprey.

As described by Montgomery and MacDonald (2002), in-channel data are best viewed as one set of diagnostic indicators of watershed and aquatic habitat condition. To inform management decisions, it is important to understand the reasons for these conditions and what, if any, management actions are needed to address them. This is a challenge because channel conditions are highly variable over space and time and can result from multiple pathways and processes influenced by both natural conditions and human impacts (Lisle et al. 2014). Thus evaluation of reach-level channel data requires more than simple comparisons with data from reference sites. Such evaluations should use qualitative and quantitative data and information to characterize the current state of the system and the dominant natural and human-caused processes that control key variables of interest. This will generally involve consideration of the location of the reaches in the channel network, regional and local biogeomorphic context, controlling influences such as sediment supply and transport capacity, riparian vegetation, the supply of in-channel flow obstructions, and disturbance history (MacDonald and Montgomery, 2002).

Watersheds to be Analyzed

Watershed analysis, which can be conducted at several spatial scales (subbasin to subwatershed), will be used to inform plan implementation.

In the Management Focus section of the Forest Plans, the specific sub-basins (HUC-5) are identified where the Forests have committed to updating the watershed analyses for these sub-basins during the life of the Forest plans.

Other candidates for watershed analysis, in addition to the Potential WCF Priority Watersheds, would be those where: (1) watersheds wherein management activities are likely to occur that may substantially affect aquatic resources (e.g., due to their inherent nature, location, timing or scale), (2) watersheds wherein upslope and/or in-channel conditions (e.g., per PIBO data and models, WCF Assessment, and/or other applicable information) are outside or at the extremes of the distribution of reference sites/watersheds, and (3) watersheds wherein the rates of change in condition (trajectories) differ substantially from the rates in the rest of the watersheds on the Forest.

The goal is to use the results of existing monitoring and assessment programs to stratify the landscape based on broad-scale, coarse-grained evaluations of watershed condition; select watersheds from that landscape for further, finer-scale, more detailed analysis of watershed conditions and processes; and use the results of those finer-scale analyses to inform management of those specific watersheds. In addition, as more analyses are completed/updated over time, results will collectively be used to further understand conditions and trends in the entire population of watersheds on the Forest. One focus of these analyses will be to determine, where applicable, why instream conditions are outside or near the tails of the distribution of reference conditions. Are these natural conditions or were they caused by past or ongoing management actions? If management-driven, what actions are needed to facilitate recovery or maintain or improve desired conditions?

Timing

As applicable, watershed analysis will be updated or conducted prior to:

- Implementation of substantial aquatic or terrestrial restoration programs or projects in Potential WCF Priority Watersheds;
- Proposed changes to RMA widths must be supported by a watershed analysis. It is expected that RMA widths will not be less than described in the Designating Riparian Management Areas section; and
- Proposed timber salvage or construction of facilities in RMAs.

Watershed analysis is generally conducted prior to project-level NEPA. However, watershed analyses can be conducted concurrent with the NEPA process in some situations. This approach may be most appropriate where watershed analyses have been completed in the past, but need modest updates. It may also be appropriate for new analyses or significant updates, when the projects being planned and evaluated in NEPA cover a wide range of activities over large areas and multiple years.

8. Watershed Restoration Strategy

Background

Watershed protection and restoration to benefit aquatic and riparian-dependent resources and water quality is an integral element of the ARCS. Restoration, in concert with other ARCS elements, contributes to protection and recovery of those resources. Collectively, the goal of restoration and the ARCS as a whole is to provide for ecologically healthy watershed, riparian, and aquatic ecosystems, as defined by the aquatic and riparian desired conditions. The phrase "ecologically healthy" refers to functions affecting biodiversity, productivity, biochemical, and evolutionary processes that are adapted to the environmental conditions in a given region (Karr et al 1986; Karr 1991).

Watershed protection and restoration is designed to facilitate the recovery of watershed functions and related physical, biological, and chemical processes to promote recovery of riparian and aquatic composition, structure, and ecosystem function. Restoring the health and resiliency of selected watersheds will help ensure that the network of Key Watersheds remains well-represented and distributed over time.

Watershed protection and restoration is a catalyst for initiating ecological recovery (FEMAT 1993). Restoration efforts will be comprehensive, addressing both protection of existing functioning aspects of a watershed and restoration of degraded or compromised aspects. It may not be possible to restore every watershed and some restoration actions may only have limited success because of an extensive level of degradation. The effectiveness of restoration efforts is not likely to be extensive or immediately visible for some time. At the watershed scale, it may take an extended period (decades or longer) to observe the full effects of treatments. Even longer timeframes may be necessary to see changes at the regional scale.

Effective restoration at the watershed scale is a complex undertaking. Restoration programs require diagnosing watershed conditions and processes, identifying primary disturbance regimes (past, present and future), and the ability to locate, design, and implement integrated treatments to achieve the desired, watershed-scale response. To be effective, these programs need to: 1) target root causes of water quality, habitat and ecosystem change; 2) tailor restoration actions to local potential of the systems; 3) match the scale of restoration to the scale of the problem; and 4) be explicit about expected outcomes (Beechie et al. 2010). The Region accomplishes restoration through a whole watershed approach including internal and external partners, passive and active restoration, and prioritization, documentation of restoration needs, monitoring, and adaptive management.

WHOLE WATERSHED APPROACH AND PARTNERSHIPS

Water resources such as clean, cold water and healthy fish populations know no jurisdictional boundaries. To successfully fulfill agency responsibilities to maintain and restore these resources, work should be implemented across boundaries with willing neighbors and other partners in restoration. Restoration should be designed and implemented at the watershed scale. Treatment objectives and activities on NFS lands should be coordinated with other resource programs and with restoration on other ownerships. Watershed-scale restoration is an interdisciplinary effort requiring close coordination and working partnerships among multiple resource programs, other agencies, Tribal governments, watershed councils, adjacent landowners, collaborative groups, and other stakeholders and partners. Interdisciplinary skills provide both operational and technical capacity for implementing comprehensive watershed protection and restoration programs. Coordination and partnerships are essential to effectively address community and watershed-scale restoration needs and opportunities. Coordination also enhances skill and funding sources needed to sustain multi-year programs.

TYPES OF RESTORATION

Watershed restoration programs include passive and active approaches. Both are needed for a successful restoration program (Roni et al. 2002).

Passive restoration involves the protection and/or natural recovery of watersheds and aquatic and riparian ecosystems. It is applied at the landscape scale as intended to enable ecosystems to resist and recover from large-scale disturbances, such as fire, floods, and debris flows as well as chronic disturbances. Passive restoration involves planning and implementing various resource management programs and activities (e.g., fuels and timber management, recreation) in a way that maintains watershed and habitat conditions when they are in good condition and facilitates their recovery when they are not. The passive restoration is embodied in the standards and guidelines, which are design criteria that constrain management activities in an effort to maintain or improve the desired conditions. Active restoration is active intervention with integrated project activities. It focuses on re-establishment or modification of specific ecosystem processes. Active restoration is generally applied using integrated treatments (e.g., fish passage, road decommissioning and stabilization, riparian and upslope vegetation treatment, instream habitat improvement, restoration of streamflows) that are strategically applied at multiple, priority sites within a watershed. It is focused and applied on a more limited scale (e.g., specific sites in Key and Candidate Priority watersheds) than passive restoration.

Active restoration should be prioritized to emphasize the protection and/or retention of existing high-quality habitat and water and naturally functioning watersheds and ecosystems. This is accomplished by identifying and treating major risk factors (e.g., unstable roads or poorly located and/or drained roads, certain invasive plants and animals, major obstructions to physical and biological connectivity) threatening ecosystem integrity and likely to adversely influence existing conditions. Identification, prioritization, and integrated treatment of watersheds with limited loss of function and condition are also a priority. These watersheds will likely serve as the next generation of refugia for fish and provide high-quality water in the future. Their selection should consider the extent of habitat degradation and the degree to which their natural diversity and ecological processes are retained (Reeves et al. 1995). Active restoration programs should consider and complement recovery plans for fish, water quality, and other riparian-dependent species. Watershed analyses will be critical to identify key ecological processes influencing watershed condition and function and will be important in identifying specific protection and/or treatment objectives.

In cases where the full recovery of watershed functions and processes is not possible (e.g., mixed ownerships without coordinated restoration opportunities, major dams/diversions for hydropower or other developments that influence large and/or important portions of the floodplain or stream channel), mitigation treatments may be needed. These should incorporate design features to benefit aquatic and riparian-dependent resources.

Programmatic Framework

In 2005, the Pacific Northwest Region began implementing a Regional Aquatic Restoration Strategy (ARS, USDA Forest Service 2005), providing a framework for the organization and implementation of restoration activities for the Region. The goal of the ARS is to improve watershed and aquatic and riparian habitat conditions at the Regional scale, through both passive and active restoration. The Aquatic Restoration Strategy consists of three parts: 1) Goals/Objectives/Actions, 2) Program Framework, and 3) Restoration Components. The Goals/Objectives/Actions section identifies restoration goals and actions needed to achieve them. The Program Framework is the foundation of the strategy. It is a comprehensive, integrated restoration plan for the Region, enhancing teamwork, coordination, and consistency across the program. The Restoration Components are groups of activities used to implement various program elements, including resource support activities, aquatic and riparian resource assessment, cooperation between State and Federal salmon and watershed recovery programs, and technical support to the field.

Implementation of the Regional ARS has since been refined through the National Watershed Condition Framework (WCF). As shown in Figure 8, WCF is a 6-step process for restoration, including:

1. classifying watershed condition at the subwatershed scale;
2. prioritizing watersheds for restoration;
3. developing Watershed Restoration Action Plans;
4. implementing integrated projects;
5. tracking restoration accomplishments; and
6. monitoring and verifying the WCF process and its outcomes.

Classifying Watershed Condition

Classification of watershed condition is the first step of the WCF process. This classification is based on a standardized assessment of subwatersheds (12-digit HUs) across an entire national forest, using 12 different condition indicators. Additional details are provided in the Watershed Condition Classification Technical Guide (USDA Forest Service, 2011b).

Prioritizing Watersheds for Restoration

The next step in the restoration framework is prioritization. The purpose of prioritization is to maximize the efficiency and effectiveness of the restoration program by focusing resources towards work in the most important watersheds. As described in Section 6, prioritization is done in two phases. First, through the Forest planning process, Forests will identify a long-term Key Watershed network. This network is comprised of watersheds with the highest quality aquatic habitats and water and watersheds that can be most readily protected and/or restored. These watersheds, generally 10-digit HUs, are the priorities for aquatic conservation and restoration over long-timeframes (i.e., multiple decades).

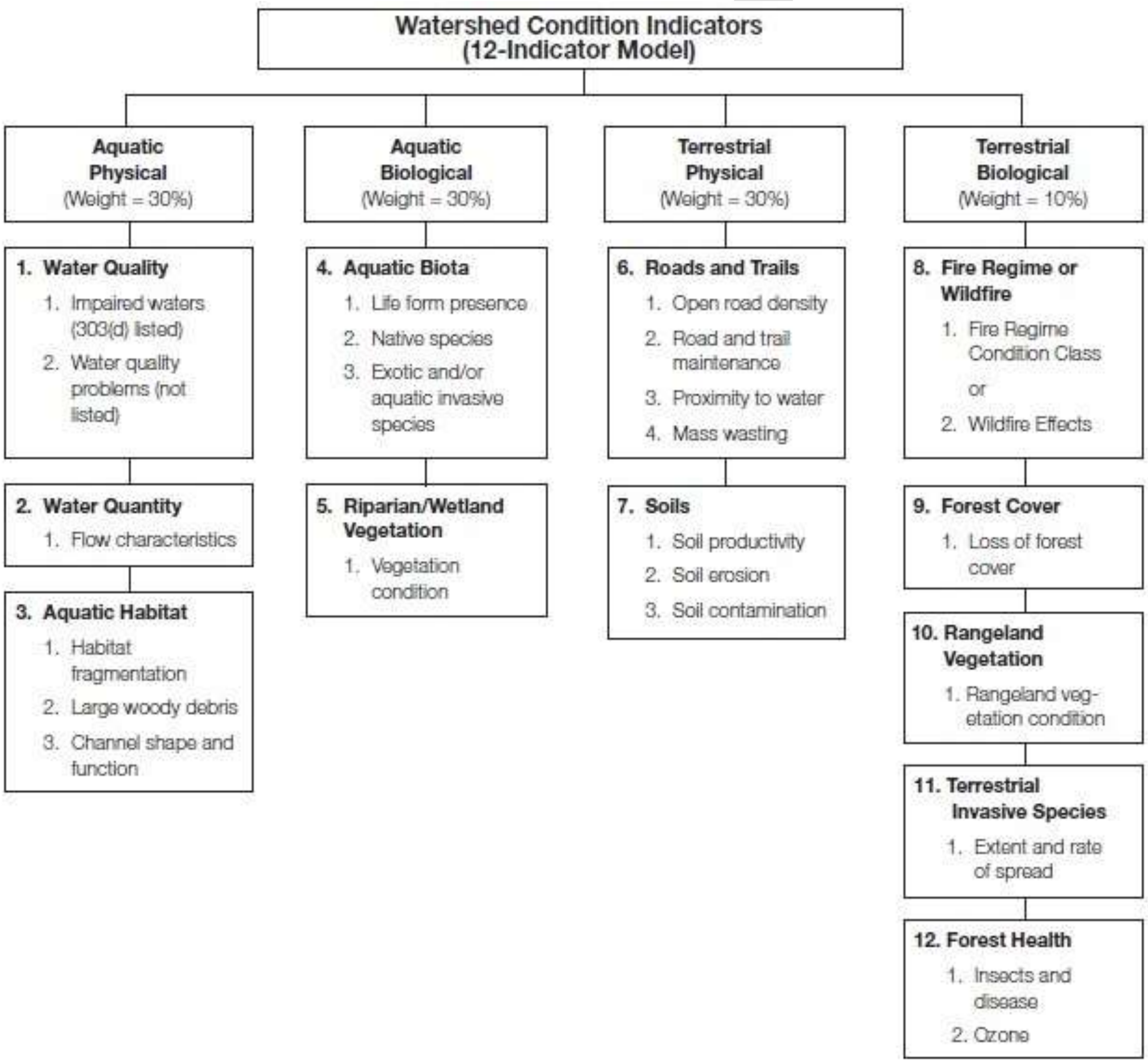

Figure 12. Twelve indicator watershed condition model used in Watershed Condition Framework. This model is used to classify watershed conditions across all subwatersheds on each national forest. Each indicator is classified as functioning properly, functioning-at-risk, or having impaired function based on standardized rulesets.

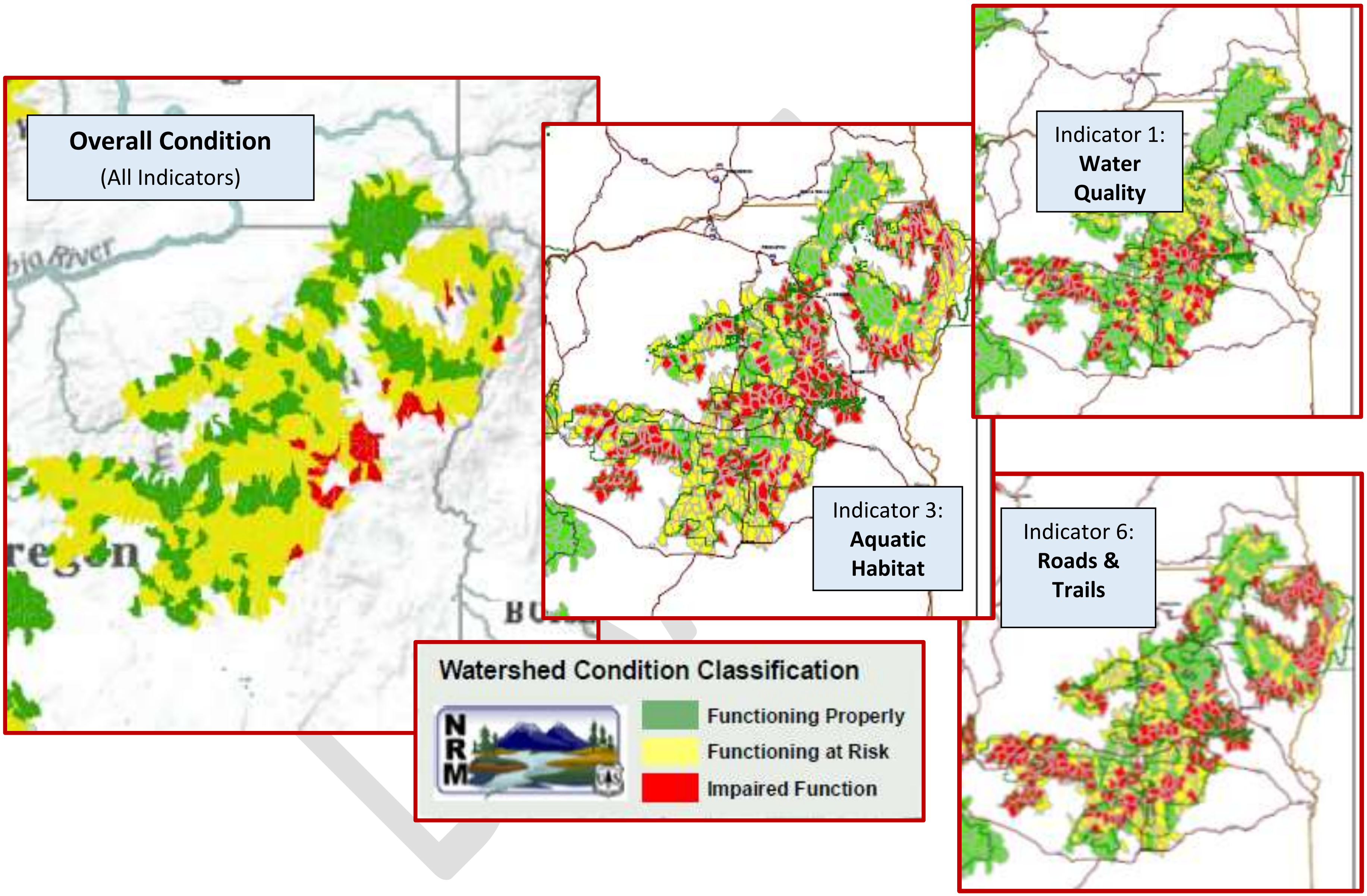

Figure 13. Overall watershed condition and the condition of three selected indicators, per WCF assessment process.

Due to capacity limitations, however, watershed-scale restoration work cannot be implemented across the entire Key Watershed network at one time or not even during the life of a Forest plan. Thus, as described in Section 6, through the Forest planning process Forests will identify a smaller number of WCF Priority Watersheds as the focus for near-term (i.e., 5-7 year timeframe) restoration. WCF Priority Watersheds are specified at the subwatershed (12-HU) scale. In general, they are a subset of the broader, longer-term Key Watershed network. Exceptions include situations where unique issues and restoration opportunities occur in areas outside of the Key Watershed network. WCF and Potential WCF Priority Watersheds are expected to change during the life of the Forest plan as restoration objectives and actions are completed. Details about how to change the Candidate Priority status of a watershed are provided in Section 6.

Developing Watershed Restoration Action Plans

Watershed restoration in the late 1980s and 1990s often focused on site-scale actions scattered across the landscape. As the practice evolved over the last several decades, it has become increasingly clear that, to be effective, restoration programs must implement a wide range of projects that address multiple impacts and threats at a watershed scale. This needs to be done in a phased and coordinated manner (Roni et al. 2002). Thus, after identifying Potential WCF Priority Watersheds, Forests will use watershed analyses (Section 10), other assessments and monitoring to identify the full-suite of "essential" restoration projects needed to restore the ecological conditions and processes in those areas at a whole watershed scale. This could include restoration of fish passage barriers, road improvements or decommissioning, stream and floodplain reconstruction, dam removal, restoration of instream flows, invasive species control, vegetation management and many other actions. This suite of essential projects should be designed to achieve specific and explicit restoration goals and objectives for the watershed, address the root causes (rather than symptoms) of degradation, be fit to the local ecological potential of the watershed and ecosystem, and be of sufficient scope and scale to address these problems (Beechie et al. 2010). Moreover, identified essential restoration projects should be based on a consideration of the potential effects of climate change and the ability of restoration actions to minimize them. In particular, water availability, streamflows and stream temperature should be considered. Identified restoration project should also be informed by and generally consistent with any applicable recovery plans for ESA-listed aquatic species and/or any State water quality restoration plans.

Per WCF, these projects, their general location, estimated costs, interested partners, and other information will be documented in a Watershed Restoration Action Plan (WRAP) for each WCF Priority Watershed. In the preparation of WRAPs, consideration shall be given to restoration actions located off NFS lands when those projects are essential to the restoration of the watershed and benefits national forest resources (e.g., facilitating the upstream passage of rare fish species from private land onto NFS lands by implementing a passage project on downstream private lands).

Tracking Restoration Accomplishments

Implementation of restoration actions will be tracked for individual essential restoration projects, as identified in a WRAPs for each WCF Priority Watershed. These will be recorded in corporate databases. In addition, once all essential projects are completed, per WCF, the watershed is considered to have been "improved" or "restored". Similarly, this status is tracked in agency databases.

Restoration project areas not specified as WCF Priority Watersheds are also recorded in agency databases.

Implementing Integrated Projects that Restore and Maintain Watershed Conditions

The overall strategy is to accelerate improvement of watershed and aquatic/riparian conditions across the landscape by: 1) conducting new and ongoing management activities in a manner that, across broad scales, protects areas in good condition and allows for passive recovery of those that are degraded; 2) actively restoring conditions at watershed scales in high-priority areas by implementing integrated, strategically-focused sets of restoration treatments that facilitate recovery of critical watershed processes.

As previously described, there are five essential elements to this Aquatic Riparian Conservation Strategy: riparian management areas, Key Watersheds, watershed analysis, watershed protection and restoration, and monitoring. These elements work together to achieve a distribution of watershed conditions that are resilient to natural disturbance, that maintain, restore, and enhance habitat for resident and anadromous fish and other aquatic and riparian dependent organisms:

Riparian management areas are areas bordering perennial and intermittent streams in which the management emphasis is to maintain, restore, or enhance the ecological health of aquatic and riparian ecosystems.

Key watersheds are subwatersheds, or groups of subwatersheds, selected to serve as strongholds for important aquatic resources or that have the potential to do so.

Watershed analysis is a procedure used within the Pacific Northwest for evaluating the geomorphic and ecological processes operating within watersheds and is used to assess the condition and trend of watershed, riparian, and aquatic ecosystems and provide the basis for watershed-scale restoration.

Watershed protection and restoration is an integrated set of both passive and active actions intended to facilitate the recovery of the physical, biological, and chemical processes that promote the maintenance or recovery of riparian and aquatic ecosystem structure and function.

Monitoring is a strategic assessment of the implementation and effectiveness of management actions and a means of determining whether or not progress toward achieving desired conditions is being made.

Implementation of the watershed protection and restoration element is tiered to the regional Aquatic Restoration Strategy, which uses a strategic, integrated, multi-scale approach to prioritizing watershed restoration treatments. The highest priority is to first restore critical watershed processes in those areas in which the structure and function of the aquatic ecosystem are largely intact, but are threatened by existing or projected watershed conditions. Watersheds with highly degraded aquatic ecosystems are a lower priority for restoration until threats to existing strongholds (e.g., Key Watersheds) are mitigated.

Watershed conditions in the Blue Mountains have been altered by a series of human uses during the last 150 years, including mining, logging, agriculture, water diversions, flood control, wildfire suppression, grazing, road construction and maintenance, and hydro-electric development. The ability of watersheds to function has been affected by the alteration of vegetation conditions, increased erosion, and changes in the rates and magnitude of watershed runoff (McIntosh et al. 1994). The resulting degradation and fragmentation of aquatic and riparian habitats has led to widespread decline or outright extinction of many resident and anadromous fish stocks and the listing of several fish stocks under the Endangered Species Act in the early 1990s. Of the 214 remaining salmonid stocks identified by Nehlsen et al. (1991) in the Columbia and Klamath basins, 101 are considered at high risk of extinction. Only 2 percent of salmon, steelhead, and cutthroat trout populations in the Columbia Basin are classified as strong (Thurow et al. 2000). In the Blue Mountains, Nehslen et al. (1991) identified 17 extinct salmonid populations:

- Spring/summer Chinook salmon from the Umatilla, Walla Walla, and Malheur Rivers. (Recent efforts by The Confederated Tribes and Bands of the Umatilla Indian Reservation have returned spring-run Chinook salmon to the Umatilla and Walla Walla Rivers.
- Fall Chinook salmon from the Umatilla and Walla Walla Rivers
- Coho salmon from the Grande Ronde, Wallowa, Tucannon, Walla Walla, Snake, and Umatilla Rivers
- Chum salmon from the Umatilla and Walla Walla Rivers
- Sockeye salmon from the Wallowa River
- Steelhead trout from the Malheur, Powder, and Burnt Rivers

In addition, Snake River Chinook salmon and steelhead are listed as threatened under the Endangered Species Act and mid-Columbia Basin steelhead are listed as threatened. Bull trout are listed as threatened within their entire range in the western United States.
In the Blue Mountains, as elsewhere in the Pacific Northwest, remaining high-quality aquatic habitats are largely located on Federal lands but are often fragmented or disconnected from other high-quality habitats, resulting in reduced ability of aquatic species to access or move between habitats. The quality and types of available habitats may no longer encompass the

range of habitats that existed historically and may not, in some cases, be sufficient to support the full range of life histories of affected aquatic species.

Aquatic habitats on National Forest System lands in the Blue Mountains once supported culturally and economically important populations of freshwater species, including anadromous and resident fishes (Chinook salmon, steelhead, redband trout, and bull trout), lamprey, and mussels. In most cases, declines in the populations of these species can be traced to habitat degradation (Gregory and Bisson 1997).

It is generally recognized that preservation of existing high-quality habitats and remaining strong populations is critical to the continued survival of anadromous and resident fish populations (Reeves et al. 1995). In addition, restoration efforts should focus on restoring the key ecological functions responsible for the creation and maintenance of aquatic and riparian habitats in order to make those ecosystems self-sustaining (Beechie and Bolton 1999, Naiman et al. 1992).

The focus of watershed restoration is to complete needed restoration work from ridgetop to valley bottom in order to have healthy watersheds. It should be recognized that not all watersheds will be in good condition at the same time and that the condition of some existing high-quality watersheds will eventually be degraded by future disturbance and that replacement habitats will be needed for some populations of aquatic and riparian species (Reeves et al. 1995).

Because of the extent of decline in populations of some aquatic species and the degradation of their habitats, protection of remaining strong populations and their habitats is crucial to their recovery (Sedell et al. 1997). A network of Key Watersheds is identified in order to meet this need. Key watersheds have a combination of relative population strength for one of four aquatic species (Chinook salmon, steelhead, inland redband trout, and bull trout), good watershed conditions, and good aquatic and riparian habitat condition (Reiss et al. 2008). Key watersheds are identified at the subwatershed level (U.S. Geological Survey, HUC 6; Federal Geographic Data Committee 2004).

Some of the attributes of Key Watersheds that make them important for aquatic species may also make Key Watersheds important habitats for terrestrial wildlife species. Key watersheds may encompass a variety of habitats important to various wildlife species, including source habitats, summer range, winter range, refugia, and migration corridors. In addition, Key Watersheds are likely to be less affected by past land uses and are therefore more likely to be important to the maintenance of water quality and quantity for a variety of downstream uses, including human uses.

The overall strategy is to protect and restore whole watersheds, while reducing risk to remaining populations of aquatic species and increasing the availability and connectivity of high quality aquatic and riparian habitats. Watersheds in good condition should be preserved by reducing existing impacts, implementing best management practices, and through more comprehensive project design. Watershed protection and restoration activities will be prioritized so that investments are made in areas that have the highest restoration potential while providing the greatest benefit to multiple resources and the least risk to existing populations. These areas are identified as Potential WCF Priority Watersheds in the project record. Restoration actions may take place in areas of lower priority as circumstances warrant and as opportunities are presented.

Land managers should recognize and seek to restore the processes responsible for creating and maintaining aquatic and riparian habitats, as well as the diversity of those habitats. This may include, but is not limited to:

- Altering the structure and composition of upland vegetation in order to make progress toward achieving desired conditions
- Managing vegetation to reduce wildfire risk and restore stand structure and resiliency
- Reducing road-related erosion and sediment delivery to streams through road closure, road obliteration, improved maintenance, and/or improved erosion control
- Removing barriers that block or restrict access to historically occupied habitats or restrict connectivity between habitats
- Altering riparian habitats to favor deciduous trees and shrubs as appropriate where such species were formerly abundant
- Reintroducing keystone species, such as beaver, into suitable habitats within their former range
- Increasing the diversity and complexity of aquatic and riparian habitats by promoting natural establishment and succession of riparian plant communities
- Restoring the natural range of stream flows to the extent possible
- Managing invasive species to maintain the composition and diversity of native species
- Restoring complexity and aquatic and riparian habitat
- Adapting management actions to account for the expected effects of climate change

Key watersheds are located in each of the 15 subbasins with streams originating on National Forest System lands. Sixty-seven subwatersheds that are considered the highest priority for restoration have restoration work that either is ongoing or is expected to begin within the next 15 years. The full list of Key Watersheds, including maps, is available from the project record. Once a WRAP is developed, essential restoration projects are implemented in a logical, phased, and coordinated way. For example, restoration of habitat connectivity is often one of the first restoration actions that should be completed in a watershed (Roni et al. 2002). Conversely, if road decommissioning is needed in a watershed, it should be conducted after any other critical work that is dependent on those particular roads is complete.

As described previously, restoration projects will be done in an interdisciplinary manner in close coordination with other agencies, Tribal governments, watershed councils, adjacent landowners, collaborative workgroups, other stakeholders and partners.

9. Monitoring

This section outlines a consistent monitoring framework for the Blue Mountains ARCS, at the broad-scale and the Forest plan level. This framework is focused on enabling managers to make informed, sound decisions by addressing key questions and reducing uncertainties at multiple scales. It is composed of an ongoing cycle of planning and implementing activities, monitoring through collection of data by observation or measurement, evaluation of those data, and subsequent adjustments in the overall process. Some components of broad-scale monitoring will be implemented by the Regional Office, whereas others will involve both Regional and Forest-level activities. Importantly, as described below, the broad-scale and Forest plan guidance of this framework are intended to efficiently work together and inform one another. Moreover, this monitoring is strongly linked with watershed analysis components of the Blue Mountains ARCS (Section 10).

Reflecting the principles of the RIEC Framework (2011) and Interior Columbia Basin Strategy (2014), this monitoring framework focuses on using monitoring to answer the following key questions:

1) Are plans being implemented correctly?
2) Are plans and activities effective in achieving desired results?
3) What is the status and trend of watersheds, water quality, aquatic and riparian resources?
4) Are underlying assumptions of the plans valid?

In addition, this monitoring framework provides a mechanism for accountability and oversight and provides a feedback loop, so that management direction and/or activities can be evaluated and modified at multiple spatial (project-level to Regional) and temporal scales (years to decades or more) by decision-makers at different levels of the agency (District Ranger to Regional Forester).

This framework uses a multi-scale approach because: 1) the ARCS and Forest plan components (e.g., desired conditions, objectives, standards and guidelines) cover a broad range of spatial and temporal scales, 2) the condition of watersheds and aquatic and riparian habitats is influenced by numerous processes operating at a similarly large range of scales, 3) the sensitivity to disturbance of different ecosystem components varies widely across those scales, and 4) monitoring feedback needs to be taken by different people at different administrative levels over varying timeframes.

Monitoring, Verification and Feedback in Restoration

Monitoring and verification coupled with feedback loops are essential to ensuring the success of restoration. As such, Forests will actively respond to monitoring by course adjusting the approach to restoration and other actions as foundational components of their restoration programs, as described in this section. The monitoring plans incorporate combination of implementation, effectiveness, and validation monitoring. Specifically there will be both WCF Monitoring and

Broad Scale Monitoring that will feed into the monitoring plans directly. Information gained from monitoring will be shared to facilitate mutual learning.

Watershed protection and restoration is founded in science. As such, there is a continuous stream of contributions to the body of knowledge. Restoration techniques should be implemented, monitored, and subsequently modified to reflect what was learned through monitoring. Information from monitoring enters a feedback loop, improving future restoration actions (Roni et al. 2002). Reporting, publishing, and disseminating the success or failure of restoration projects will not only help a particular District or Forest learn, but will assist others within and outside the agency, adding to the restoration community's knowledgebase.

Implementation, Effectiveness and Validation Monitoring

There are 3 types of monitoring: Implementation, Effectiveness and Validation Monitoring. The following defines those terms as they are referred to in the Revised Forest Plans.

Implementation monitoring is simply documenting that a project has been conducted and/or conducted according to specific design criteria (e.g., best management practices). For example, when an aquatic organism project is implemented, the action would be documented in the Regional Barrier Database, so the Forest and Region can track accomplishments.
Effectiveness monitoring evaluates how effectively a project met its intended goal. For example, when an aquatic organism project is implemented, effectiveness monitoring would evaluate whether previous impacts to stream channel structure and function have been eliminated or reduced (e.g., does the crossing simulate a natural stream channel?). Costs for effectiveness monitoring should be included in project budgets.

Validation monitoring, generally the most expensive form of the three monitoring approaches, validates assumptions made in effectiveness monitoring. Because of its generally higher cost, validation monitoring is usually performed on a small subset of the overall number of projects. This level of experimental design would generally be conducted with FS Research, universities, or other research organizations.

Validation monitoring is intended to verify the following question: *Are correctly implemented projects yielding the effectiveness monitoring we anticipated?* If the answer is "no", then the agency is committed to validation monitoring as a way to rigorously assess the validity of our assumptions. Validation monitoring would be an outcome of our implementation and associated effectiveness monitoring. Validation monitoring would only be developed as needed to address specific concerns. It would be conducted the least frequently of all monitoring activities, given the relatively large cost and long timeframes to address these types of questions. Currently, no specific validation monitoring questions have been identified as priorities to address via broad-scale or regional monitoring.

Potential adaptive management actions would usually be taken by the Regional Forester. They would generally focus on significant issues occurring over broad areas (e.g., millions of acres). Actions could include changes to this strategy (ARCS), direction to Forests to develop new plan direction or adjust approaches to implementing current plan direction, and adapting or replacing inaccurate analysis models.

Broad-scale and Forest Plan Implementation-scale Monitoring

Monitoring under this planning effort will occur at both broad and plan implementation scales.

Broad-scale Monitoring

Broad-scale Monitoring would generally be authorized and funded by the Regional Forester. This type of monitoring would generally focus on significant issues occurring over broad areas (i.e., many Forests). Actions could include development or refinement of Regional policies and procedures, training and functional assistance trips to Forests, and direction to Forests to focus additional resources towards certain activities. These actions would generally occur over short to medium time-scales (e.g., one to 5 years).

Additional effectiveness monitoring will be conducted on a prioritized ad-hoc basis. Current broad-scale effectiveness monitoring activities are focused on evaluating the effectiveness of road restoration in reducing the hydrologic and geomorphic impacts of roads and improving habitat connectivity at road-stream crossings.

The following Regional monitoring programs will be used to address this question:

- Aquatic and Riparian Effectiveness Monitoring Program (AREMP), in western OR and WA and northern CA; and
- PACFISH/INFISH Biological Opinion Monitoring Program (PIBO), in the Interior Columbia River Basin

While the precise methods used by these programs differ somewhat, they generally involve the collection, gathering, and evaluation of data regarding upslope watershed conditions and instream aquatic habitat conditions.

The PIBO monitoring is a long-term monitoring program that is designed to support implementation and effectiveness monitoring in the Interior Columbia Basin particularly with regards to instream habitat and riparian condition (Figure 14) and (Figure 15).

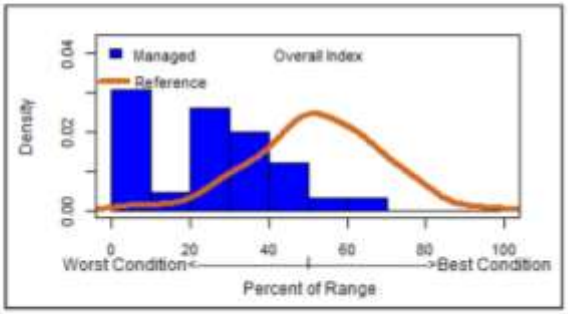

Figure 14. Status and trends of stream habitat conditions on the Malheur National Forest, 2001-2012.

Metric	Desired Change	Actual Change (%)
Overall Habitat Index	+	+8.8
Macroinvertebrates	+	+3.3
Streambank Stability	+	+5.2
% Undercut Streambanks	+	+16.4
Large Wood Frequency	+	+34.1
Bank Angle	-	-2.6
% Fines in Pool Tails	-	+1.8
Median Substrate Size	+	+9.3
Residual Pool Depth	+	+10.2
% Pools	+	-4.7

The figure shows the current status of stream habitat conditions via an overall habitat index (Archer and Ojala, 2016 using the approach of Al-Chockhachy et al. 2010). The accompanying table shows trends in the overall habitat overall index as well as for individual habitat metrics. Cells highlighted in dark green show metrics that have statistically significant changes in the desired direction (+ or -). Metrics in light green cells have changed in the desired direction, but the changes are not statistically significant. Metrics shown in light red have changed in the direction opposite of what is desired, but those changes are not significant. Future monitoring will continue to evaluate status and trends in managed and reference condition watersheds.

Use of long term monitoring, such as PIBO, support adaptive management actions that would generally be taken by local line officers (District Rangers or Forest Supervisors). Use of these datasets could include increasing or decreasing the type, scope, scale or location of different activities (e.g., watershed restoration, timber harvest, road building or decommissioning, fuels treatment, livestock grazing) or the implementation of other plan components (e.g., standards and guidelines). These actions would generally occur over moderate to long time-scales (e.g., a decade or more).

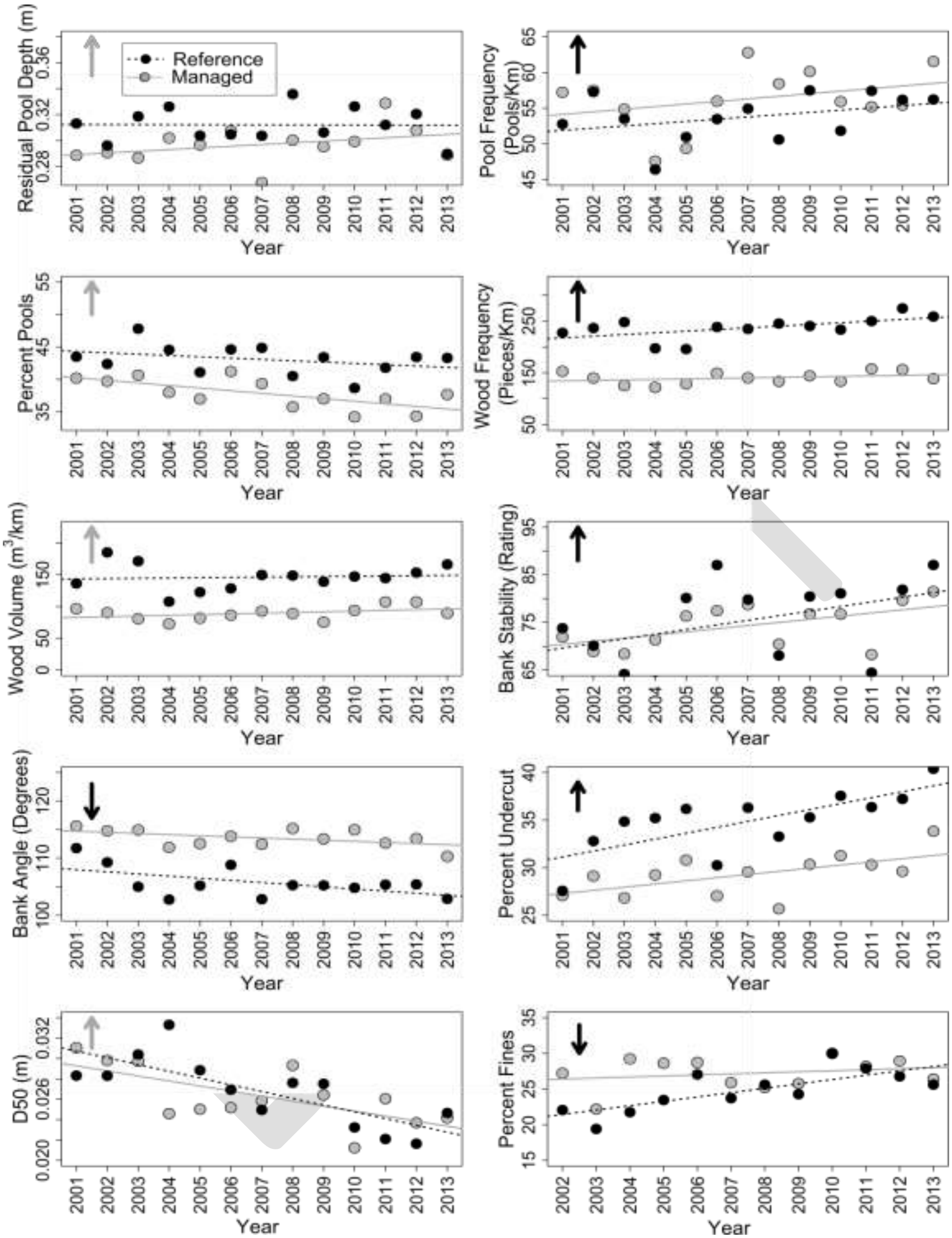

Figure 15. Trends in habitat conditions in reference and managed watersheds on Federal lands in the interior Columbia Basin, 2001-2012 (Roper et al. 2016). *Arrows point to the direction of desired conditions based on PACFISH/INFISH Riparian Management Objectives (RMOs, black) or the literature (grey).*

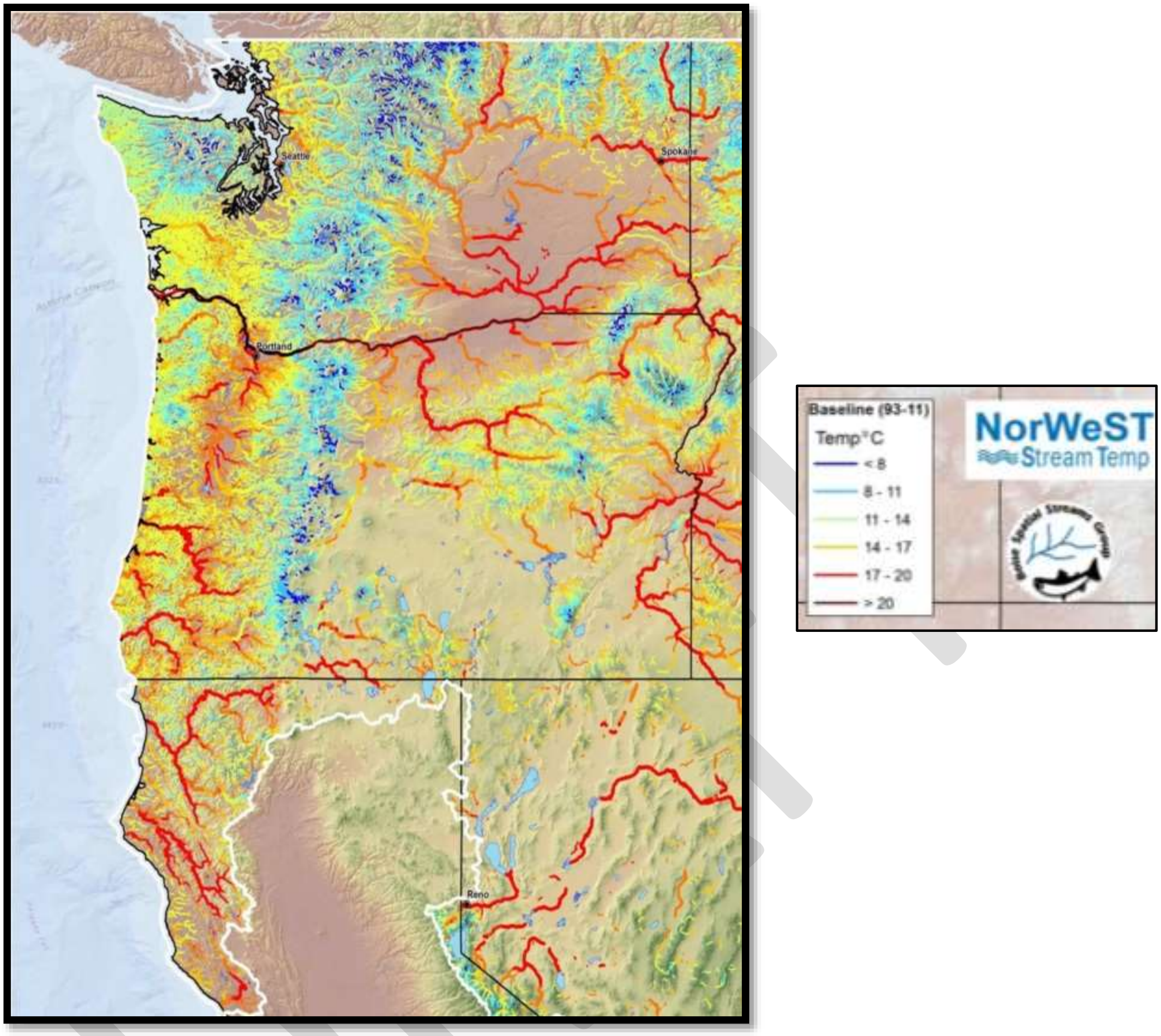

Figure 16. Spatial distribution of average August stream temperatures for the 1993-2001 baseline period. Ongoing monitoring by National Forests, other Federal agencies, States, Tribes and non-governmental organizations will enable similar products to be developed in the future, so that temporal trends can be characterized.

Forest Plan Implementation Monitoring

Implementation monitoring is intended to comply with the 2012 Planning Rule. The Forest Plan monitoring that correlates most directly to the Blues Mountains ARCS is also responsive to the 2012 Planning Rule 219.12.a.5, elements i-iv, vi and vii (Attachment A)

- i) status of watershed conditions.
- ii) status of select ecological conditions
- iii) status of ecological conditions (see 219.9) related to T&E, candidate, and conservation concern species
- iv) status of surrogate species (related to 219.9 Diversity)
- vi) changes due to climate change and other stressors
- vii) progress toward meeting DCs and Objectives, including multiple use opportunities.

Implementation may happen at the District and/or Forest scale. Implementation monitoring would measure the effects of various activities such as, watershed restoration, timber harvest, grazing, road building, decommissioning, or fuels treatment.

Linkage between Monitoring, Watershed Analysis and Restoration

The products of broad-scale status and trend monitoring will be used as part of watershed analysis for specific watersheds. Analysis teams will, for example, use those data to characterize how upslope and instream conditions and trends for a particular watershed fit within the distribution of conditions and trends across all reference and managed watersheds within a larger area (e.g., subbasin, basin, Forest). From there, they will identify and use other information for the watershed of interest to more completely and accurately assess watershed and aquatic habitat conditions, the reasons (cause/effect) those conditions exist (e.g., natural disturbance or human impacts), what actions might be warranted in the watershed and generally how and where they should be implemented. They may also choose to develop attributes of watershed-specific desired conditions based, in part, on products from broad-scale monitoring.

Second, the watershed condition assessment, associated with the watershed condition framework, serve as a coarse form of long-term monitoring. These assessments will be completed on a regular timeframe and before each plan revision, for use by analysis teams to determine changes in watershed condition and species viability between plan revisions. This information can be used to inform future plan development, revisions or amendments, as well as specific watershed restoration planning.

10. Coordination and Cooperation

Internal and external coordination and cooperation is essential to ensure successful management of waters and their associated riparian areas and biota. As such, USFS collaborated with representatives from other federal, state, and local agencies, Tribal Nations, organizations to develop the Blues ARCS. Additionally, USFS Watershed and Fisheries professionals collaborate with each other and with colleagues within and outside the agency to accomplish management goals for aquatic and riparian habitat. USFS professionals work with neighboring landowners, representatives of other federal, state, and local agencies, Tribal Nations, organizations, and individuals to cooperatively manage watersheds across ownership boundaries. Sharing personnel and resources is essential to successful borderless whole watershed management.

Considering limited personnel and funding, collaboration between agencies with a role in the management of fish and wildlife resources is necessary for any of the agencies to fulfill their mission. This has always been true, but has become a necessity today as science continues to illuminate the complexities of the management of water quality and fish and wildlife species within the ecosystems in which they occur. Management actions such as rare species management, habitat restoration, stocking, harvest, and invasive species control and eradication require collaboration. As such, the USFS will continue to collaborate with other agencies, organizations, and Tribal Nations with the development and implementation of conservation agreements and strategies. The USFS will continue to cooperate with Federal, tribal, and State fish management agencies to identify and eliminate impacts associated with habitat manipulation, fish stocking, harvest, and poaching that may threaten the continued existence and distribution of native fish stocks occurring on Federal lands. Forests will cooperate with State and Tribal agencies when aquatic invasive species eradication projects are proposed. Forests will also coordinate and cooperate with State water and water quality management agencies to better align and integrate programs and ensure compliances with applicable laws and regulations.

11. Risks and Uncertainties

As with any strategy designed to protect and restore ecosystems, it is uncertain whether either the Regional ARCS or the Blues ARCS will achieve the outlined goals. There are risks that it may not. These risks and uncertainties stem from several key factors. First, the knowledge base is incomplete regarding these highly complex systems. These knowledge gaps mean that the ARCS may be missing key components. Moreover, the effectiveness of some existing aspects of the strategy has not been fully demonstrated. For instance, there are few examples of successful restoration at the scales of interest (i.e., typically watershed or subbasin, over long-timeframes). At the same time, new threats, such as climate change and invasive species, have emerged and substantially increased risks to and uncertainties associated with aquatic ecosystems.

Besides risks and uncertainties associated with the composition of the ARCS, full implementation of the strategy is not guaranteed. For example, implementation is strongly dependent on budgets and a robust, highly-skilled workforce with access to extensive resource information. Capacity in the region has declined substantially in the past 20 years and future declines are possible. Another key source of risk and uncertainty is the fact that the ARCS pertains only to NFS lands in the Pacific Northwest Region and portions of the Pacific Southwest Region. It does not apply to habitat impacts (including dam operations) and biological impacts (including the introduction of non-native fish) off National Forests or activities on other Federal lands and State and private lands. These activities have had and will continue to have a large influence on the maintenance and recovery of aquatic ecosystems and water quality.

12. Conclusion

This strategy is designed to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on NFS lands throughout the Blue Mountains National Forests. It is part of a single, unified strategy that synthesizes, integrates, and refines the existing strategies in the region: PACFISH and INFISH. Consistent with these existing strategies, the goal of the Blue Mountain ARCS is to develop networks of properly functioning watersheds supporting populations of fish, other aquatic and riparian-dependent organisms, and State-designated beneficial uses of water across the Region while enabling provision of ecosystem services for multiple uses, including outdoor recreation, range, timber, and wildlife.

This ARCS adopts and builds upon the basic structure and elements of existing strategies because science supports their general framework and assumptions; they appear to be working; and there is general public support for them. However, the ARCS includes some specific refinements to provide better alignment with recent science and information and new policy direction, particularly the 2012 Planning Rule as pertains to Monitoring. It also incorporates lessons learned during 20-years of implementing those strategies.
The ARCS provides the plan components (e.g., desired conditions, suitability, objectives, and standards and guidelines) and other plan content to guide watershed, aquatic and riparian resource management.

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12. Abbreviations

ACS: Aquatic Conservation Strategy
ARCS: Aquatic and Riparian Conservation Strategy
AREMP: Aquatic and Riparian Effectiveness Monitoring Program
ARS: Aquatic Restoration Strategy
BMP: Best Management Practices
CMZ: Channel Migration Zone
CTUIR: Confederated Tribes of the Umatilla Indian Reservation

CWA:	Clean Water Act
DC:	Desired Condition
EDT:	Ecosystem Diagnosis and Treatment
FEMAT:	Forest Ecosystem Management Assessment Team
FTG:	Forest Type Group
GRAIP:	Geomorphic Road Analysis and Inventory Package
HU:	Hydrologic Unit
ICS:	Interagency Coordinators Subgroup
ISAB:	Independent Scientific Advisory Board
IWWI:	Inland West Watershed Initiative
KWS:	Key Watersheds
MAM:	Monitoring and Adaptive Management
NHD:	National Hydrologic Data Set
NRV:	Natural Range of Variation
NWFP:	Northwest Forest Plan
PIBO:	PACFISH/INFISH Biological Opinion Monitoring Program
PWS:	Priority Watersheds
RHCA:	Riparian Habitat Conservation Area
RMA:	Riparian Management Area
RMO:	Riparian Management Objective
SPTH:	Site Potential Tree Height
WCF:	Watershed Condition Framework
WRAP:	Watershed Restoration Action Plan

13. Glossary

Anadromous fish: fish that spend their early life in freshwater, move to the ocean to mature, and then return to freshwater to reproduce.

Anchor population*:* population stronghold, source for supplementing or refounding smaller, more vulnerable surrounding populations.

Active floodplain: Active floodplain is defined as the area bordering a stream inundated by flows at a surface elevation defined by two times the maximum bankfull depth (measured at the thalweg).

Active Restoration: The deliberate activities related to restoration. As an example, this might include seeding native grasses and planting native scrubs and trees.

Assessment: The identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents, but provide current information on select topics relevant to the plan area, in the context of the broader landscape (2012 Planning Rule).

Aquatic (and riparian) health: Aquatic and riparian habitats that support animal and plant communities that can adapt to environmental changes and follow natural evolutionary and biogeographic processes. Healthy aquatic and riparian systems are resilient and recover rapidly from natural and human disturbance. They are stable and sustainable, maintaining their organization and autonomy over time, and are resilient to stress. In a healthy aquatic/riparian system there is a high degree of connectivity from headwaters to downstream reaches, from streams to floodplains, and from subsurface to surface. Floods can spread into floodplains, and

fish and wildlife populations can move freely throughout the watershed. Healthy aquatic and riparian ecosystems also maintain long-term soil productivity. Mineral and energy cycles continue without loss of efficiency. (www.icbemp.gov/) [Section 1, page 5]
Aquatic ecosystem: Any body of water, such as a stream, lake or estuary, and all organisms and nonliving components within it, functioning as a natural system. FEMAT glossary http://www.reo.gov/library/policy/ROD/FEMAT.pdf
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act (1980).
Channel migration zone: "Channel migration zone (CMZ)" means the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings. CMZs are those areas with a high probability of being subject to channel movement based on the historic record, geologic character and evidence of past migration. It should also be recognized that past action is not a perfect predictor of the future and that human and natural changes may alter migration patterns. Consideration should be given to such changes that may have occurred and their effect on future migration patterns.
Coarse filter management: Land management that addresses the needs of all associated species, communities, environments and ecological processes in a land area. (see fine filter management.) *(FS People's Glossary of Eco Mgmt Terms)*
Connectivity: The arrangement of habitats that allows organisms and ecological processes to move across the landscape. Patches of similar habitats are either close together or linked by corridors of appropriate vegetation. The opposite of fragmentation. (www.icbemp.gov/) [pg 33]
Connectivity (of habitats): The degree in which habitat patches are connected.
Decommission: To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. Another term for this is "hydrologic obliteration." FEMAT glossary
Desired Conditions: Descriptions of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates.
Ecological health: - The state of an ecosystem in which processes and functions are adequate to maintain diversity of biotic communities commensurate with those initially found there. FEMAT glossary
Ecosystem health: A condition where the parts and functions of an ecosystem are sustained over time and where its capacity for self-repair is maintained, such that goals for uses, values, and services of the ecosystem are met. (www.icbemp.gov)
Evolutionary Significant Unit (ESU): a group of salmon or trout populations that is a distinct population segment. Scientists established two criteria for ESUs: 1) the population must show substantial reproductive isolation; and 2) there must be an important component of the evolutionary legacy of the species as a whole.
Facultative Plants: Plants that occur usually (estimated probability >67 percent to 99 percent) in wetlands, but also occur (estimated probability 1 percent to 33 percent) in nonwetlands (USCOE Wetlands Delineation Manual).

Fine-filter management: Management that focuses on the welfare of a single or only a few species rather than the broader habitat or ecosystem (see coarse filter management). *(FS People's Glossary of Eco Mgmt Terms)*
Forest road or trail: A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization (Title 36, Code of Federal Regulations, Part 212—Administration of the Forest Transportation System, section 212.1.)
Fresh Water: Water that generally contains less than 1,000 milligrams-per-liter of dissolved solids (EPA glossary).
Geographic Areas: Spatially contiguous land areas identified within the planning area. A geographic area may overlap with a management area.
Guidelines: Constraints on project and activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met (36 CFR 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
Herbicide: A chemical pesticide designed to control or destroy plants, weeds, or grasses. (EPA glossary)
Hyporheic zone: The hyporheic zone is a region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone (termed hyporheic flow) is recognized to be important for surface water/groundwater interactions, as well as fish spawning, among other processes.
INFISH: Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (Forest Service). (www.icbemp.gov/)
Insecticide: A pesticide compound specifically used to kill or prevent the growth of insects. (EPA glossary)
Landscape: a collection of biophysical elements and ecosystem types that occupy relatively large (10^5-10^7 acres) contiguous areas (Hunter 1996, Concannon et al. 1999).
Leasable minerals: Minerals that may be leased to private interests by the Federal government. Leasable minerals include oil, gas, geothermal resources, and coal. FEMAT glossaryhttp://www.reo.gov/library/policy/ROD/FEMAT.pdf
Long-Term recovery: Amount of time needed to achieve desired conditions for watershed function (overall properly functioning watershed conditions), through natural processes, in the absence of management. This maximum timeframe at minimum shall not be slowed by management action, and may be accelerated as a consequence of management action. Overall positive effects of a project on watershed function, would be projected to last as long, or longer, than the duration of short-term adverse effects and continue to promote recovery of natural watershed function and processes overall once short-term adverse effects are no longer occurring.
Maintain: to produce no change in the existing conditions of a resource relative to their condition status; i.e., properly functioning, functioning at risk, or not functioning properly. Conditions that are “maintained” are neither restored nor degraded, but remain essentially the same as the existing condition. The term “maintain” can apply to any condition indicator at the appropriate scale, but those scales need to be identified. “Degrade” applies when actions change the existing condition to one that’s measurably worse.

Management areas: Land areas identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous.
Meta-population: A population comprising local populations that are linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events. FEMAT glossaryhttp://www.reo.gov/library/policy/ROD/FEMAT.pdf
Mitigation: Modifications of actions taken to:

- avoid impacts by not taking a certain action or parts of an action;
- minimize impacts by limiting the degree or magnitude of the action and its implementation;
- rectify impacts by repairing, rehabilitating, or restoring the affected environment;
- reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or,
- compensate for impacts by replacing or providing substitute resources or environments.

Municipal Supply Watershed: A watershed that serves a public water system as defined in the Safe Drinking Water Act of 1974, as amended (42 U.S.C. §§ 300f, et seq.); or as defined in state safe drinking water statutes or regulations.
Natural Range of Variation (NRV): The variation of ecological characteristics and processes over scales of time and space that are appropriate for a given management application. In contrast to the generality of historical ecology, the NRV concept focuses on a distilled subset of past ecological knowledge developed for use by resource managers; it represents an explicit effort to incorporate a past perspective into management and conservation decisions (adapted from Weins, J.A. et al., 2012). The pre-European influenced reference period considered should be sufficiently long, often several centuries, to include the full range of variation produced by dominant natural disturbance regimes such as fire and flooding and should also include short-term variation and cycles in climate. The NRV is a tool for assessing the ecological integrity and does not necessarily constitute a management target or desired condition. The NRV can help identify key structural, functional, compositional, and connectivity characteristics, for which plan components may be important for either maintenance or restoration of such ecological conditions.
Objectives: Concise, measurable, and time-specific statements of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets.
Obligate species: A plant or animal that occurs only in a narrowly defined habitat such as tree cavity, rock cave, or wet meadow. FEMAT glossary http://www.reo.gov/library/policy/ROD/FEMAT.pdf
PACFISH: Interim Strategies for Managing Pacific Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. (www.icbemp.gov/)
Passive Restoration: Allowing a site to self-restore through natural processes
Pesticide: Substances or mixture there of intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant. (EPA glossary)
Priority watershed: Priority Watersheds are a subset of Key Watersheds. There are two types of Priority Watersheds, one that applies to the Watershed Condition Framework and the other that applies to the plan period, known as Potential WCF Priority Watersheds, both are 12-digit

hydrologic unit watersheds. The WCF watersheds have been established under the agency's Watershed Condition Framework (WCF) process as the focus for investments in the short term (5-7 years) for maintenance or improvement of watershed conditions (soil and hydrologic functions supporting aquatic ecosystems). An overview of the WCF and WCF reference materials can be found here: http://www.fs.fed.us/biology/watershed/condition_framework.html. The Potential WCF Priority Watersheds were identified with regards to those areas that will receive restoration emphasis during the plan period (15 years).

Recovery unit: A management sub-unit of a Federal ESA-listed entity, geographically or otherwise identifiable, that is essential to the recovery of the entire listed entity. It conserves genetic or demographic robustness, important life history stages, or other feature for long-term sustainability of the entire listed entity. Recovery criteria for the listed entity should address each identified recovery unit. Every recovery unit must be recovered before the species can be delisted.

Reference Condition: A set of selected measurements or conditions of unimpaired or minimally impaired water bodies characteristic of a water body type in a region. A standard or benchmark for a river monitoring program that measures physical and/or biological integrity.

Refugia: Locations and habitats that support populations of organisms that may be limited to small fragments of their previous geographic range (i.e., endemic populations). FEMAT glossary http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Resilience: The ability of an ecosystem to maintain diversity, integrity, and ecological processes following a disturbance. *(FS People's Glossary of Eco Mgmt Terms) REO Information Center-Definitions*

Resiliency: The degree to which the system can be disturbed and recover to a state where processes and interaction function as before (Holling 1973 in Reeves et al 1995).

Resilient: (1) The ability of a system to respond to disturbances. Resiliency is one of the properties that enable the system to persist in many different states or successional stages. (2) In human communities, refers to the ability of a community to respond to externally induced changes such as larger economic or social forces. (www.icbemp.gov)

Restore: generally applies when the existing conditions are outside the range of desired conditions and actions are specifically designed and implemented to move toward desired conditions for one or more at-risk/impaired resource in a watershed.

Retard attainment: applies when management action effects, individually or in combination with other management actions or natural disturbances, measurably shows the natural rate of recovery towards the desired conditions.

Riparian-dependent resources: (see 2526.05 - Definitions) Riparian-Dependent Resources. Resources that are dependent upon the habitat conditions (cool, shady, moist) that occur in riparian areas.

Riparian ecosystem: An ecosystem that is a transition between terrestrial and aquatic ecosystems. It includes the vegetation communities associated with rivers, streams, lakes, wet areas and their associated soils which have free water at or near the surface. An ecosystem whose components are directly or indirectly attributed to the influence of water (www.icbemp.gov).

Riparian habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Salable minerals: High volume, low value mineral resources, including common varieties of rock, clay, decorative stone, sand, and gravel. FEMAT glossary http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Short-Term adverse effects: Duration and spatial extent of adverse effects to individual parameters and overall watershed condition, relative to natural rates at which desired conditions for watershed function in the watershed would otherwise be achieved, would be determined by the project hydrologist or fish biologist. Short-term adverse effects may occur when their implementation would either immediately or eventually help create improved watershed functions and conditions that would inherently last longer than the duration of the short-term adverse effects and become relatively self-sustaining through natural processes in the absence of continued management activity. Determining short-term effects to individual parameters for the sake of long-term recovery of overall watershed function, will need to be determined project-by-project based on best-available science and professional judgement by hydrology and fisheries specialists.

An example of short-term adverse effects that would not be detrimental to longer-duration watershed function would be when elevated sediment inputs and accumulation associated with a project site would be expected to fully flush out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures would be expected to prevent future project related sediment inputs into the stream (NMFS 2013). Clean Water Act TMDLs for temperature and sediment, where they exist, also help define short-term adverse effects for specific watersheds in the planning area. As an additional example, fish passage projects may have block fish passage for up to a few weeks during removal and upgrade of a structure that seasonally blocks passage, with the goal of improving fish passage for many years to come (NMFS 2013).

As a last example, for streams listed for temperature under the Clean Water Act, where TMDLs for temperature do not exist yet, short-term project effects in streams listed as 303d for temperature would not be allowed to exceed temperature levels established as beneficial uses for salmonid species, specifically temperature levels that support the life histories and habitat usage by bull trout. Salmon and steelhead where they are present, short-term effects from invasive plant control were defined in the NMFS Regional Biological Opinion for Aquatic Restoration (NMFS 2013) as being no more than 10% of the acres in an RHCA in any one 6th HUC in a given year.

Site potential: A measure of resource availability based on interactions among soils, climate, hydrology, and vegetation. Site potential represents the highest ecological status an area can attain given no political, social, or economic constraints. It defines the capability of an area, its potential, and how it functions. (www.icbemp.gov/)

Site-potential tree: A tree that has attained the average maximum height possible given site conditions where it occurs. FEMAT glossary http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Site potential tree height (SPTH): The average maximum height of the tallest trees (200 years or older) for a given site class. (http://www.icbemp.gov/)

Spatial: Related to or having the nature of space. (http://www.icbemp.gov/)

Standards: Mandatory constraints on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
Temporal: Related to time. (http://www.icbemp.gov/)
Unstable and potentially unstable lands: The unstable land component includes lands that are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which in turn will affect aquatic ecosystems, including streams, seeps, wetlands, and marshes. (www.icbemp.gov/)
Watercourse: A watercourse is any flowing body of water. These include rivers and streams. A natural stream of water fed from permanent or periodical natural sources and usually flowing in a particular direction in a defined channel, having abed and banks or sides, and usually discharging itself Into some other stream or body of water.
Watershed: The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the streamflow at that point.

a) The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. *(FEMAT, IX-39)*
b) Any area of land that drains to a common point. A watershed is smaller than a river basin or subbasin, but it is larger than a drainage or site. The term generally describes areas that result from the first subdivision of a subbasin, often referred to as a "fifth-field watershed." *(Ecosystem Analysis at the Watershed Scale v 2.2, p. 25)*
c) The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the stream flow at that point. *(FS People's Glossary of Eco Mgmt Terms)*

Watershed condition classes: Watersheds are rated as Class 1, 2, or 3.

Class 1 Condition: Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Drainage network is generally stable. Physical, chemical, and biological] conditions suggest that soil, aquatic, and riparian systems are predominantly functional in terms of supporting beneficial uses.
Class 2 Condition: Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biological conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses.
Class 3 Condition: Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. A majority of the drainage network may be unstable. Physical, chemical, and biological conditions suggest that soil, aquatic, and riparian systems do not support beneficial uses.

Wetlands: Those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Attachment A. Document Tables

Table 1. Excerpt of aquatic and fish related monitoring from the Blue Mountains Forest Plans.

Proposed Monitoring Question	Proposed Indicator						Plan Component
	Parameter	Related Programs/ Indicators	Monitoring Frequency, Evaluation Frequency	Monitoring Type	Precision/ Reliability	Why? L: legal requirement S: strategic C: consultation	
1. Status of select watershed conditions. Key ecosystem characteristics related to water resources and watershed conditions, such as water quality, quantity, timing and distribution provide the basis for monitoring watershed conditions.							
What is the status and trend of water quality?	Miles of state-listed impaired waters	State 303d-list	5 years	Implementation, effectiveness	Moderate	L, S, C	1.11 Water Quality
What is the status and trend of stream temperature?	Stream temperature	NRIS-AqS temperature data, other agency databases, RMRS stream temperature models	Annual, 10 years	Implementation, effectiveness	Moderate	L, S, C	FOR-6 G-38
What is the status and trend of streamflows?	Streamflow	Federal and state agency databases and Forest Service databases	Annual, 10 years	Implementation, effectiveness	Moderate	S, C	1.1.1 Hydrologic Function
Are watershed/aquatics standards and guidelines and BMPs being implemented at project sites (e.g., range, roads, recreation, and vegetation management)?	Multiple	Project files, field observations	Annual, 2 years	Implementation	High	L, S, C	1.1 Watershed Function

Proposed Monitoring Question	Proposed Indicator: Parameter	Related Programs/ Indicators	Monitoring Frequency, Evaluation Frequency	Monitoring Type	Precision/ Reliability	Why? L: legal requirement S: strategic C: consultation	Plan Component
Are watershed/aquatics standards and guidelines and BMPs effective at achieving desired on-site conditions at project sites (e.g., range, roads, recreation, and vegetation management)?	Multiple	Field observations	Annual, 2 years	Effectiveness	Moderate	L, S, C	1.1 Watershed Function
What is the status and trend of watershed condition in all watersheds and in key watersheds?	Multiple watershed condition indicators and attributes	Forest Service and other agency databases	5 years	Effectiveness	Moderate	S, C	1.1 Watershed Function
What is the status and trend of riparian vegetation condition?	PIBO effectiveness	PIBO and forest datasets	Annual, 5 years	Effectiveness	Moderate	L,S, C	1.1.2 Riparian Function
What is the change in the distribution of known sites for selected aquatic and riparian invasive species?	Presence of selected invasive species	Federal and state agency databases and Forest Service databases	Annual, 5 years	Implementation, Effectiveness	High	S, C	1.5 Invasive Species
What is the status and trend of aquatic habitat?	Miles of stream habitat improved, PIBO effectiveness	Forest Service databases, PIBO datasets	Annual, 5 years	Effectiveness	Moderate	L,S, C	1.1.6 Aquatic Habitat
What is the status and trend of aquatic habitat connectivity?	Miles of stream reconnected	Forest Service databases	Annual, 5 years	Effectiveness	High	L,S, C	1.1.6 Aquatic Habitat
3. Status of select set of the ecological conditions required under §219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.							

Proposed Monitoring Question	Proposed Indicator						Plan Component
	Parameter	Related Programs/ Indicators	Monitoring Frequency, Evaluation Frequency	Monitoring Type	Precision/ Reliability	Why? L: legal requirement S: strategic C: consultation	
What is the condition, trend and distribution in habitats for aquatic surrogate species (steelhead, spring Chinook salmon, bull trout, and redband trout	See Status and Trend-Aquatic habitat, Status and Trend-Aquatic Habitat Connectivity	Forest Service databases, PIBO datasets	Annual, 5 years	Implementation, Effectiveness	Moderate	L, S, C	1.2 Species Diversity
What is the condition and trend of white bark pine	Acres infected/uninfected	Forest Service databases,	Annual, 5 years	Implementation, Effectiveness	Moderate	L, S, C	1.13 Special Habitat
4. Status of surrogate species to assess the ecological conditions required under§ 219.9.							
What are the trends in source habitat and risk factors for boreal owl (UMA only), western bluebird, and fox sparrow?	Changes due to management or disturbance events	Accomplishment reports, FACTS, Fire GIS layer, open route density (boreal owl and western bluebird only)	2 years, 5 years	Implementation, effectiveness	Moderate	S	1.2 Species Diversity
What are the trends in source habitat and risk factors for Cassin's finch?	Changes due to management or disturbance events	Accomplishment reports, FACTS, Fire GIS layer	2 years, 2 years (5 years for alternatives B, C, and F, UMA only)	Implementation, effectiveness	Moderate	S	1.2 Species Diversity
What is the trend of northern goshawk (alternative C only)?	Follow established protocols			Implementation, effectiveness	Moderate	S	WLD-HAB-9
What are the trends in whitebark pine survival and recruitment?	Whitebark pine survival and recruitment	Whitebark pine transects and plots	5 years, 5 years	NA	Moderate	S	1.13 Special Habitats

Proposed Monitoring Question	Proposed Indicator: Parameter	Related Programs/ Indicators	Monitoring Frequency, Evaluation Frequency	Monitoring Type	Precision/ Reliability	Why? L: legal requirement S: strategic C: consultation	Plan Component
6. Measurable changes on other plan area related to climate change and other stressors that may be affecting the plan area.							
Does new scientific information related to climate change indicate a need to change plan components?	New scientific findings	Best available scientific information	5 years	5 years	Low	S	1.2 Species Diversity, 2.11 Community Resiliency
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.							
Are hydrologically connected roads being addressed consistent with plan direction?	Miles treated of hydrologically connected roads	GIS, INFRA, MVUM	Annual, 5 years	Implementation	High	S	WR-3, RMA-RD-10 G-123 RMA-RD-3, Objective Improve hydrologic function
Are watershed/aquatic restoration projects (e.g., road decommissioning, passage improvements, riparian stream habitat improvements, etc.) being implemented at a rate consistent with forest plan objectives?	Annual accomplishment metrics (e.g., road miles decommissioned)	Forest Service databases	Annual	Implementation	High	S, C	1.1 Watershed Function

Table 2. Key and Priority Watersheds for the Malheur National Forest. Acres are total NFS acres and may include parts of adjacent national forests.

HUC12	Watershed Name	Category	Acres
170501160101	Upper Big Creek	P	12,632
170501160102	Lake Creek	P	19,944
170501160103	Bosonberg Creek-Malheur River	P	14,749
170501160104	Summit Creek	P	23,261
170501160105	Cliff Creek-Malheur River	KWS	29,342
170501160201	Headwaters Wolf Creek	P	11,428
170501160202	East Fork Wolf Creek	P	12,553
170501160203	Squaw Creek-Wolf Creek	P	11,540
170501160204	Calamity Creek	P	31,400
170501160301	Upper Pine Creek	P	26,562
170501161101	Swamp Creek-North Fork Malheur River	P	25,560
170501161102	Elk Creek-North Fork Malheur River	P	13,523
170501161103	Crane Creek	P	28,734
170501161105	Skagway Creek-North Fork Malheur River	P	11,005
170501161201	Upper Little Malheur River	KWS	31,513
170702010104	Utley Creek	KWS	9,264
170702010205	Upper Deer Creek	KWS	16,061
170702010206	Lower Deer Creek	KWS	12,237
170702010301	Headwaters Murderers Creek	KWS	28,960
170702010303	Upper Murderers Creek	KWS	10,087
170702010305	Lower Murderers Creek	KWS	3,157
170702010501	Headwaters John Day River	KWS	24,554
170702010502	Deardorff Creek	KWS	10,861

170702010503	Reynolds Creek	KWS	16,382
170702010505	Dads Creek-John Day River	KWS	7,093
170702010601	Strawberry Creek-John Day River	KWS	9,644
170702010605	Indian Creek	KWS	12,236
170702010606	Castle Creek-John Day River	KWS	6,347
170702010701	Upper Canyon Creek	KWS	22,753
170702010702	East Fork Canyon Creek	KWS	15,433
170702010906	Dry Creek-John Day River	KWS	6,344
170702011002	Fields Creek	KWS	10,801
170702030101	Squaw Creek	P	11,145
170702030102	Summit Creek	P	13,246
170702030103	Dry Fork	P	11,242
170702030104	Clear Creek	P	12,145
170702030105	Bridge Creek	P	11,468
170702030106	Mill Creek-Middle Fork John Day River	P	16,661
170702030201	Vinegar Creek-Middle Fork John Day River	P	18,360
170702030202	Little Boulder Creek-Middle Fork John Day River	P	17,431
170702030203	Granite Boulder Creek-Middle Fork John Day River	P	22,594
170702030204	Big Boulder Creek	P	11,460
170702030205	Upper Camp Creek	P/WCF	18,800
170702030206	Lick Creek	P/WCF	10,470
170702030207	Lower Camp Creek	P/WCF	10,569
170702030208	Balance Creek-Middle Fork John Day River	P	11,172
170702030301	Bear Creek-Middle Fork John Day River	P	18,273
170702030302	Big Creek	P	17,737
171200020103	Upper Scotty Creek	KWS	10,160

171200020201	Upper Bear Creek	KWS	19,161
171200020302	Camp Creek	KWS	24,626
171200020403	Myrtle Creek	KWS	26,910
171200020501	Crowsfoot Creek-Emigrant Creek	KWS	13,680
171200020502	Whiskey Creek-Emigrant Creek	KWS	19,060
171200020503	Bear Canyon Creek	KWS	11,470
171200020504	Little Emigrant Creek-Emigrant Creek	KWS	23,039
171200020505	Cricket Creek	KWS	22,792
171200020506	Sawtooth Creek	KWS	12,453
171200040201	Still Spring Creek-Silver Creek	P	14,922
171200040202	Delintment Creek-Silver Creek	P	17,606
171200040203	Dodson Creek	P	11,679
171200040204	Sawmill Creek	P	14,371
	Number of Priority Watersheds/Total Acres:	34	537,400
	Number of key Watersheds/Total Acres:	28	453,975

Table 3. Key and Priority Watersheds for the Umatilla National Forest. Acres are total NFS acres and may include parts of adjacent national forests.

HUC12	Watershed Name	Category	Acres
170502020101	Upper North Fork Burnt River	KWS	16,147
170601030201	North Fork Asotin Creek	KWS	25,012
170601030202	Lick Creek	KWS	8,218
170601030203	South Fork Asotin Creek	KWS	11,910
170601030204	Charley Creek	KWS	9,241
170601030206	Upper George Creek	KWS	8,735
170601041002	Little Lookingglass Creek	KWS	20,648
170601060301	Upper South Fork Wenaha River	KWS	20,250
170601060302	Lower South Fork Wenaha River	KWS	14,760
170601060303	North Fork Wenaha River	KWS	17,586
170601060304	Beaver Creek	KWS	12,485
170601060305	Rock Creek-Wenaha River	KWS	14,389
170601060306	Upper Butte Creek	KWS	16,822
170601060307	Lower Butte Creek	KWS	11,800
170601060308	Cross Canyon-Wenaha River	KWS	19,482
170601060309	Upper Crooked Creek	KWS	18,987
170601060310	First Creek	KWS	13,576
170601060311	Lower Crooked Creek	KWS	16,585
170601060312	Dry Gulch-Wenaha River	KWS	6,148
170601070601	Headwaters Tucannon River	P	24,508
170601070602	Panjab Creek	P	16,265
170601070603	Little Tucannon River-Tucannon River	P	16,221
170601070604	Cummings Creek	P/WCF	8,696

HUC12	Watershed Name	Category	Acres
170701020101	Upper South Fork Walla Walla River	KWS	17,595
170701020102	Middle South Fork Walla Walla River	KWS	14,068
170701020201	Upper Mill Creek	KWS	19,456
170701020301	Upper North Fork Touchet River	KWS	15,587
170701030104	North Fork Umatilla River	KWS	17,476
170701030202	East Meacham Creek	KWS	11,949
170701030203	Butcher Creek-Meacham Creek	KWS	9,892
170701030204	North Fork Meacham Creek	KWS	30,287
170701030205	Camp Creek-Meacham Creek	KWS	15,740
170701030206	Boston Canyon-Meacham Creek	KWS	8,084
170702020204	Clear Creek	P/WCF	19,411
170702020205	Lake Creek	P	11,884
170702020206	Lower Granite Creek	P	19,012
170702020301	Glade Creek-North Fork John Day River	KWS	12,970
170702020302	Meadow Creek	KWS	20,649
170702020303	Big Creek	KWS	17,744
170702020304	Corral Creek-North Fork John Day River	KWS	18,342
170702020401	Headwaters Desolation Creek	P	15,054
170702020402	Upper Desolation Creek	P	21,076
170702020403	Middle Desolation Creek	KWS	13,325
170702020404	Lower Desolation Creek	KWS	6,750
170702020702	West Fork Meadow Brook	KWS	8,529
170702020706	Ellis Creek-Potamus Creek	KWS	14,938
170702020707	Potamus Creek	KWS	13,871
170702020801	Swale Creek	P	13,147

HUC12	Watershed Name	Category	Acres
170702020802	Little Wall Creek	P	19,656
170702020803	Skookum Creek-Little Wall Creek	P	20,546
170702020804	Wilson Creek	P	14,886
170702020805	Upper Big Wall Creek	P/WCF	15,631
170702020806	Lower Big Wall Creek	P	11,567
	Number of Priority Watersheds/Total Acres:	15	244,604
	Number of key Watersheds/Total Acres:	37	552,980

Table 4: Key and Priority Watersheds for the Wallowa-Whitman National Forest. Acres are total NFS acres and may include parts of adjacent national forests.

HUC12	Watershed Name	Category	Acres
170502010601	Upper Pine Creek	P	18,011
170502010603	Clear Creek	P	14,895
170502010605	East Pine Creek	P	15,921
170502010606	Fish Creek-Pine Creek	P	5,434
170502010607	Upper North Pine Creek	P	18,784
170502010608	Lake Fork Creek	KWS	19,969
170502010609	Lower North Pine Creek	KWS	13,890
170502020101	Upper North Fork Burnt River	KWS	16,088
170502020102	Camp Creek	KWS	17,075
170502020103	Patrick Creek-North Fork Burnt River	KWS	8,099
170502020104	Trout Creek	KWS	19,150
170502020105	Petticoat Creek-North Fork Burnt River	KWS	12,718
170502020106	West Fork Burnt River	KWS	8,694
170502020107	Middle Fork Burnt River	KWS	11,406
170502020201	Upper South Fork Burnt River	KWS	20,136
170502020202	Middle South Fork Burnt River	KWS	19,754
170502020301	Higgins Reservoir-Camp Creek	KWS	11,976
170502020302	Higgins Reservoir-Camp Creek	KWS	10,056
170502030101	Cracker Creek	KWS	18,141
170502030105	Deer Creek	KWS	19,267
170502030404	Rock Creek	KWS	12,026
170502030501	Upper North Powder River	KWS	12,061
170502031002	West Eagle Creek	KWS	12,526

HUC12	Watershed Name	Category	Acres
170502031004	East Fork Eagle Creek	KWS	26,345
170601020101	North Fork Imnaha River	KWS	13,303
170601020102	South Fork Imnaha River	KWS	17,779
170601020103	Rock Creek-Imnaha River	KWS	11,136
170601020301	Salt Creek-Big Sheep Creek	P	13,626
170601020302	Lick Creek	P	10,235
170601020303	Tyee Creek-Big Sheep Creek	P/WCF	11,865
170601020304	Carrol Creek-Big Sheep Creek	P	8,553
170601020306	Steer Creek-Big Sheep Creek	KWS	14,922
170601020407	Lower Little Sheep Creek-Big Sheep Creek	KWS	4,354
170601040101	Tanner Gulch-Grande Ronde River	P	15,245
170601040102	Limber Jim Creek	P	11,945
170601040103	Meadowbrook Creek-Grande Ronde River	P	12,780
170601040104	Chicken Creek	P	10,965
170601040105	Sheep Creek	P/WCF	18,996
170601040106	Little Fly Creek	P	10,583
170601040107	Upper Fly Creek	P	10,324
170601040108	Lower Fly Creek	P	8,912
170601040109	Warm Springs Creek-Grande Ronde River	P	17,119
170601040201	Upper Meadow Creek	KWS	16,907
170601040202	Middle Meadow Creek	KWS	21,400
170601040203	Upper McCoy Creek	KWS	12,145
170601040204	Lower McCoy Creek	KWS	5,585
170601040205	Dark Canyon Creek	KWS	9,988
170601040206	Lower Meadow Creek	KWS	18,165

HUC12	Watershed Name	Category	Acres
170601040304	Spring Creek	KWS	13,325
170601040306	Rock Creek	KWS	5,823
170601040401	Upper Five Points Creek	KWS	13,159
170601040402	Pelican Creek	KWS	11,637
170601040403	Lower Five Points Creek	KWS	11,806
170601040501	North Fork Catherine Creek	P	21,581
170601040502	South Fork Catherine Creek	P	15,175
170601040503	Milk Creek-Catherine Creek	P	4,777
170601040504	Little Catherine Creek	P	6,902
170601040506	Little Creek	P	3,175
170601040702	Mill Creek	P	5,663
170601040901	Upper Indian Creek	P	14,873
170601050101	West Fork Wallowa River-Wallowa River	KWS	26,925
170601050102	Upper Prairie Creek	KWS	1,745
170601050106	Hurricane Creek	KWS	18,530
170601050108	Spring Creek	KWS	4,743
170601050109	Wallowa Lake-Wallowa River	KWS	4,396
170601050201	Upper Lostine River	KWS	11,207
170601050202	Lake Creek-Lostine River	KWS	17,070
170601050203	Silver Creek-Lostine River	KWS	13,859
170601050204	Lower Lostine River	KWS	1,611
170601050401	Upper Bear Creek	KWS	21,670
170601050402	Lower Bear Creek	KWS	14,789
170601050501	Upper Minam River	KWS	22,571
170601050502	China Cap Creek-Minam River	KWS	21,845

HUC12	Watershed Name	Category	Acres
170601050503	North Minam River	KWS	13,983
170601050504	Chaparral Creek-Minam River	KWS	22,479
170601050505	Little Minam River	KWS	29,036
170601050506	Trout Creek-Minam River	KWS	22,806
170601050507	Lower Minam River	KWS	4,239
170601060401	Upper Chesnimnus Creek	KWS	14,807
170601060402	Devils Run Creek	KWS	12,902
170601060403	Middle Chesnimnus Creek	KWS	17,814
170601060407	Peavine Creek	KWS	15,115
170601060502	Elk Creek	KWS	9,719
170601060504	Sumac Creek-Joseph Creek	KWS	9,623
170601060506	Davis Creek	KWS	7,968
170601060507	Lower Swamp Creek	KWS	14,902
170601060508	Cougar Creek-Joseph Creek	KWS	12,983
17060106wah0601	Peavine Creek-Joseph Creek	KWS	11,242
170601060602	Rush Creek-Joseph Creek	KWS	5,670
170601060604	Broady Creek	KWS	10,270
170702020101	Baldy Creek-North Fork John Day River	KWS	17,096
170702020102	Trail Creek	KWS	12,320
170702020103	Onion Creek-North Fork John Day River	KWS	9,771
170702020201	Upper Granite Creek	P	9,140
170702020202	Bull Run Creek	P/WCF	18,767
170702020203	Beaver Creek	P	12,119
	Number of Priority Watersheds/Total Acres	28	346,363

HUC12	Watershed Name	Category	Acres
	Number of key Watersheds/Total Acres	68	946,699

Table 5. List of Watersheds with Watershed Analysis, Assessment Name and year of Assessment, by Forest. Numbers in parentheses are number of watersheds with completed analyses and number of assessments completed (some analyses covered multiple watersheds). Watersheds with existing watersheds that will be revised during the plan period are highlighted in gray and the row is bold/italics.

Forest	NHD HUC10	NHD HUC Name	Assessment Name	Year
Malheur (17/17)	1705011601	Headwaters Malheur River	Malheur Headwaters	2000
	1705011602	Wolf Creek	Wolf Cr. (L. Malheur)	1996
	1705011603	Pine Creek	Pine Creek (L. Malheur)	1996
	1705011605	Griffin Creek-Upper Malheur River	Muddy Creek (L. Malheur)	1996
	1705011611	Upper North Fork Malheur River	Upper North Fork Malheur	1995
	1707020101	Upper South Fork John Day River	Upper South Fork John Day River	1995
	1707020102	Middle South Fork John Day River	Deer Creek	2000
	1707020103	Murderers Creek	Murderers Creek	1997
	1707020106	Grub Creek-John Day River	Prairie City/Strawberry	1997
	1707020107	Canyon Creek	Canyon Creek	2004
	1707020301	Bridge Creek-Middle Fork John Day River	Upper Middle Fork John Day	1998
	1707020302	Camp Creek -Middle Fork John Day River	Galena	2002
	1712000203	Upper Silvies River	Upper Silvies	2000
	1712000204	Middle Silvies River	Silvies Canyon	2000
	1712000205	Emigrant Creek	Emigrant	1997
	1712000401	Claw Creek	Wickiup	1998
	1712000402	Upper Silver Creek	Silver Creek	1998
Forest	**NHD HUC10**	**NHD HUC Name**	**Assessment Name**	**Year**
Umatilla (14/10)	1706010302	George Creek-Asotin Creek	Asotin	1996
	1706010408	Willow Creek	Phillips Gordon/Willow	2001
	1706010411	Cabin Creek-Grande Ronde River	Phillips Gordon/Willow	2001
	1706010601	Grossman Creek-Grande Ronde River	Grande Ronde - Rondawa	2004
	1706010705	Pataha Creek	Tucannon	2002
	1706010706	Upper Tucannon River	Tucannon	2002
	1707010301	Headwaters Umatilla River	Umatilla	2001
	1707010302	Meacham Creek	Meacham	2001
	1707020201	Headwaters North Fork John Day River	Upper North Fork John Day	1996
	1707020204	Desolation Creek	Desolation	1999
	1707020205	Upper Camas Creek	Camas Creek	1995
	1707020206	Lower Camas Creek	Camas Creek	1995
	1707020207	Potamus Creek-North Fork John Day River	Potamus	2006

	1707020208	Wall Creek	Wall	1995
Forest	**NHD HUC10**	**NHD HUC Name**	**Assessment Name**	**Year**
Wallowa-Whitman (25/19)	1705020106	Pine Creek	Pine Creek	1998
	1705020201	North Fork Burnt River	North Fork Burnt River	1995
	1705020202	South Fork Burnt River	South Fork Burnt River	1999
	1705020203	Camp Creek	South Fork Burnt River	1999
	1705020301	Upper Powder River	Upper Powder	1998
	1705020305	North Powder River	North Powder - Wolf Cr.	1999
	1705020306	Wolf Creek-Powder River	North Powder - Wolf Cr.	1996
	1705020310	Eagle Creek	Eagle Creek	1997
	1706010201	Upper Imnaha River	Upper and Lower Imnaha	1998
	1706010202	Middle Imnaha River	Upper and Lower Imnaha	1998
	1706010203	Upper Big Sheep Creek	Big Sheep	1995
	1706010204	Lower Big Sheep Creek	Big Sheep	1995
	1706010205	Lower Imnaha River	Upper and Lower Imnaha	1998
	1706010401	Upper Grande Ronde River	Upper Grande Ronde River	1994
	1706010402	Meadow Creek	Meadow Creek	2002
	1706010403	Beaver Creek-Grande Ronde River	Beaver Creek	1998
	1706010404	Five Points Creek-Grande Ronde River	Spring Cr. - Five Points	1995
	1706010405	Upper Catherine Creek	Catherine Creek	1999
	1706010502	Lostine River	Lostine	1997
	1706010505	Minam River	Minam	1999
	1706010604	Chesnimnus Creek	Upper Joseph	1995
	1706010605	Upper Joseph Creek	Upper Joseph	1995
	1706010606	Lower Joseph Creek	Lower Joseph	2002
	1707020202	Granite Creek	Granite Creek	1997
	1707020301	Bridge Creek-Middle Fork John Day River	Upper Middle Fork John Day	1998

Attachment B. Use of the Matrix of Pathways and Watershed Indicators and Watershed Condition Framework to Replace RMOs

Riparian Management Areas – Functions and Ecological Processes

Introduction

The PACFISH and INFISH strategies adopted riparian management objectives (RMOs) for stream and streamside conditions to provide criteria against which attainment or progress toward attainment of the riparian goals would be measured. Interim RMOs provided conditions which land managers would strive to achieve as they conducted management activities across the landscape in the absence of Ecosystem Analysis. It was not expected that the objectives would be met instantaneously, but rather would be achieved over time. The intent of interim RMOs was also not to establish a ceiling for what constitutes good habitat conditions. However, measurable RMOs did provide a benchmark so management actions would not reduce habitat quality and a way to gage inconsistency with the purpose of the interim direction.

The revised Blue Mountains Land Management Plans (LMPs) builds upon and refines the concepts and components of the interim aquatic strategies by developing a comprehensive Aquatic Riparian Conservation Strategy (ARCS) that replaces direction within existing Land and Resource Management Plans (LRMPs), as amended by Pacfish/Infish, and the 1995 and 1998 Biological Opinions (BOs) for listed fish species. The revised LMPs will use Watershed Condition Indicators (WCIs) within the 1996 National Marine Fisheries Service (NMFS) and 1998 U.S. Fish and Wildlife Service (FWS) matrix of pathways and indicators (MPIs) in drainages that support listed/proposed fish and/or their designated/proposed critical habitat. The revised plan will also use either the 12 core indicators within the Forest Service Watershed Condition Framework (WCF) and/or the MPIs within drainages that do not support listed/proposed fish species. The use of both approaches will replace INFISH and PACFISH interim RMOs. This approach is consistent with the 2014 Interior Columbia Basin Strategy that states, "Future conditions/objectives should be based on indicators that are reliably measurable and relevant to the conditions described."

The WCI values within the MPIs were taken from the original Matrices developed by NMFS (1996) and the FWS (1998). The analysis that led to development of default values involved managed and unmanaged watersheds in Oregon, Washington, and Idaho that included both inland native fish and anadromous fish. Like RMOs, WCIs do not to establish a ceiling for what constitutes good watershed and aquatic conditions. However, they do provide quantitative and qualitative diagnostic criteria to assist in evaluating attainment or progress towards attainment of multiple aquatic and riparian desired conditions and compliance with key standards and guidelines. A cross-walk provided in Table 1 so it is clear how certain Matrix and WCF indicators tie to specific LMP desired conditions. Measurable WCIs provide a benchmark by which changes to landscape conditions resulting from management activities and natural processes can be measured over time. It is not expected that aquatic and riparian desired conditions will be met instantaneously, but rather they will be moved toward, or achieved, over time. Attainment of these desired conditions is expected to result in diverse and complex habitats capable of providing the combination of habitat features important for the life-history requirements of the native fish communities, including ESA listed fish, and the dynamic ecological processes that sustain them over time. It will also facilitate compliance with the water quality standards and other requirements of the Clean Water Act (CWA).

The use WCIs is to provide a diagnostic tool to assist land managers and Level 1 teams in assessing how well their management actions are designed to implement the Forest Plan and move toward related resource goals and desired conditions. Specifically, WCIs in this Appendix will assist in:

1. Identifying how management actions may potentially influence the condition and trend of water, riparian, and aquatic resources, including native and non-native fish habitat and a variety of other beneficial uses of water designated by the States via the CWA.

2. Making ESA effects determinations to listed/proposed fish species and their designated/proposed important to assessing ESA compliance.

Table 1. Cross-walk between RMOs, MPI WCIs, WFC Indicators and Blue Mountains LMP Desired Conditions

RMOs	MPI Appropriately (bull trout) /Properly Functioning Appropriately WCIs	Watershed Condition Framework Indicator	Blue Mountain Desired Conditions
Bull Trout Local Population Characteristics within Core Areas			
	Subpopulation Size **Bull Trout**: Mean total subpopulation size or local habitat capacity more than several thousand individuals. All life stages evenly represented in the subpopulation. **Steelhead/Chinook**: no indicator		FLS-1 Federally listed species (aquatic and terrestrial) are recovered or delisted. Management activities improve the conservation status of listed species and designated critical habitat. Habitats are managed in accordance with conservation planning documents, recovery plans, best available scientific information, and local knowledge. Critical habitat components (i.e., Primary Constituent Elements and Primary Biological Features) are protected and restored to achieve species recovery. • For listed aquatic species, on NFS lands spawning, rearing, and migratory habitat is widely available and inhabited. Listed aquatic species have access to historic habitat and appropriate life history strategies (i.e., resident, fluvial, adfluvial and anadromy) are supported. Recovery is promoted through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups. • For listed terrestrial species, habitat that adequately provides ample resources for all life stages is available and inhabited. Recovery is promoted through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups. • For listed plant species, threats such as invasions by aggressive, nonnative plants, adverse livestock grazing management, and changes in fire frequency and seasonality are addressed. Populations achieve recovery through cooperation and coordination with tribes, state agencies, federal agencies, and other interested groups. AQ-1 Aquatic habitats contribute to ecological conditions capable of supporting self-sustaining populations of

			native species and diverse plant, invertebrate, and vertebrate aquatic and riparian-dependent species. Aquatic habitats are key for the recovery of threatened and endangered fish species and provide important habitat components for all native aquatic species.
	Growth and Survival **Bull Trout**: Subpopulation has the resilience to recover from short-term disturbances (e.g. catastrophic events, etc.) or subpopulation declines within one to two generations (5 to 10 years)[1]. The subpopulation is characterized as increasing or stable. At least 10 plus years of data support this estimate.[2] **Steelhead/Chinook**: no indicator		SD-1 The natural range of habitats for native and desired nonnative fish, wildlife, and plant species, including threatened and endangered species, species identified as regional forester's sensitive species, and surrogate species, is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity. This includes the ability of species and individuals to interact, disperse, and find security within habitats in the planning area. These habitat conditions are resilient and sustainable considering the range of possible climate change scenarios. Scale: The desired condition for species diversity can be applied at a variety of scales (i.e., forestwide, watershed, and subwatershed). During project analysis and implementation, this desired condition should be used concurrently with information outlined in the strategy and design criteria part of this plan and with consideration of the best available climate change projections. SD-2 Population strongholds for the fish surrogate species provide high quality habitat and support expansion and recolonization of species to adjacent unoccupied habitats. These areas conserve key demographic processes likely to influence the sustainability of aquatic species.
	Life History Diversity and Isolation **Bull Trout**: The migratory form is present and the subpopulation exists in close proximity to other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring	**Aquatic Biota** 1. Life Form Presence 2. Native Species	SD-1 see above SD-2 see above

	subpopulations are large with high likelihood of producing surplus individuals or straying adults that will mix with other subpopulation groups. [1] **Steelhead/Chinook**: no indicator		
	Persistence and Genetic Integrity **Bull Trout**: Connectivity is high among multiple (5 or more) subpopulations with at least several thousand fish each. Each of the relevant subpopulations has a low risk of extinction. [1] The probability of hybridization or displacement by competitive species is low to nonexistent. **Steelhead/Chinook**: no indicator	**Aquatic Biota** 2. Native Species 3. Exotic and/or Invasive Species	AQ-4 Native fish species have access to historically occupied aquatic habitats and connectivity between habitats allows for the interaction of local populations. Migratory habitats support juvenile and adult mobility and survival between spawning, rearing, overwintering, and foraging habitats that contain areas that: • are free of obstruction and excessive levels of predators of federally listed aquatic species; • have minimal physical, biological, or water quality and quantity impediments (including permanent, partial, intermittent, or seasonal barriers); and • contain natural cover such as large wood, aquatic vegetation, rocks and boulders, side channels, and undercut banks. WF-3 Connectivity exists within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide unobstructed routes to areas critical for fulfilling all life history requirements of aquatic, riparian-dependent, and upland species of plants and animals.
Water Quality			
Water Temperature No measureable increase in maximum water temperature (7 day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period). Maximum water temperature below 59ºF within adult holding	**Temperature** **Bull Trout**: 7 day average maximum temperature in a reach during the following life history stages: [1,3] Incubation 2 - 5° C Rearing 4 - 12° C Spawning 4 - 9° C	**Water Quality** 1. Impaired Waters (303d Listed)	AQ-1 see above AQ-3 Aquatic habitat elements (e.g., substrate, pools, cover, food, water quality and quantity) are in properly functioning and are sufficiently distributed to ensure egg and embryo survival, fry emergence, and juvenile survival of aquatic species to support self-sustaining populations of native resident and anadromous fish. Spawning and rearing areas contain a minimal amount of fine sediment, ranging in size from silt to coarse sand.

habitat and below 48ºF within spawning and rearing habitats.	Also temperatures do not exceed 15° C in areas used by adults during migration (no thermal barriers). **Steelhead/Chinook**: 50-57° F[16]		WQ-1 Water quality (e.g., temperature, turbidity, and dissolved oxygen) of surface and groundwater is sufficient to support healthy riparian, aquatic, and wetland ecosystems. It is within the range that maintains the biological, physical, and chemical integrity of the system and is capable of benefiting the survival, growth, reproduction, and mobility of individuals composing aquatic and riparian communities. WQ-2 The quality of water within and emanating from the national forests is sufficient to provide for state-designated beneficial uses, including human uses and meets applicable local, state, and tribal water quality criteria. WQ-3 Water quality in streams within the national forests is sufficient to meet applicable state, local, and tribal water quality criteria. RMA-2 The species composition and structural diversity of native plant communities in riparian management areas, including wetlands, provides adequate side channels, pools, undercut banks and unembedded substrates. These conditions result in a variety of depths, gradients, velocities, and structure for seasonal thermal regulation, nutrient filtering, appropriate rates of erosion, and channel migration and supplies amounts and distributions of coarse woody debris and fine particulate organic matter sufficient to sustain physical complexity and stability.
	Sediment (in areas of spawning and incubation; rearing areas will be addressed under the indicator "Substrate Embeddedness" **Bull Trout**: Similar to chinook salmon[1]: for example:(e.g.,): < 12% fines (< 0.85 mm) in gravel; [4] (< 20% surface fines of < 6 mm. [5,6]		AQ-1 see above AQ-3 see above WQ-1 see above WQ-2 see above WQ-3 see above

	Steelhead/Chinook: <12% fines (<0.85mm) in gravel, [4], turbidity low		
	Chemical Contamination/Nutrients **Bull Trout/Steelhead/Chinook**: Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no Clean Water Act 303(d) designated reaches. [8]	**Water Quality** 1. Impaired Waters (303d Listed) 2. Water Quality Problems (Not Listed)	AQ-1 see above AQ-3 see above WQ-1 see above WQ-2 see above WQ-3 see above
Habitat Access			
	Physical Barriers **Bull Trout/Steelhead/Chinook**: Man-made barriers present in watershed allow upstream and downstream fish passage at all flows.	**Aquatic Habitat** 1. Habitat Fragmentation	AQ-1 see above AQ-3 see above
Habitat			
	Substrate Embeddedness **Bull Trout**: Reach embeddedness <20% [9,10] **Steelhead/Chinook**: dominant substrate is gravel or cobble (interstitial spaces clear) or embeddedness <20%[4]		AQ-1 see above AQ-3 see above SC-1 The sediment regime under which aquatic ecosystems evolved is maintained, including the timing, volume, rate and character of input, storage, and transport.
Large Woody Debris East of Cascade Crest in Oregon, Washington, Idaho, Nevada, and western Montana >20 pieces per mile; >12" diameter; >35' length	**Large Woody Debris** **Bull Trout**: Current Eastside values are being maintained at >20 pieces/mile >12 inches diameter >35 feet length; [11,] also adequate sources of woody debris available for both long and short term recruitment. **Steelhead/Chinook**: >20 pieces/mile >12 inches diameter > 35 feet length; [7] and adequate sources of woody debris recruitment in riparian areas.	**Aquatic Habitat** 3. Channel Shape and Function	AQ-3 see above AQ-7 Aquatic habitats in which the distribution of conditions (e.g., bank stability, substrate size, pool depths, size and frequencies, channel morphology, large woody debris size and frequency) in the population of watersheds on the Forest is similar to the distribution of conditions in the population of similar, reference condition watersheds. The distribution of conditions in individual streams vary depending on valley, riparian, and channel characteristics.

Pool Frequency Channel Width (ft.) No. Pools/Mile 10 96 20 56 25 47 50 26 75 23 100 18 125 14 150 12 200 9	**Pool Frequency and Quality:** **Bull Trout**: Pool frequency in a reach closely approximates: **Wetted** width (ft) # pools/mile 0-5 feet 39 5-10 feet 60 10-15 feet 48 15- 20 feet 39 20-30 feet 23 30-35 feet 18 35-40 feet 10 40-65 feet 9 65-100 feet 4 (Can also use formula: pools/mi= 5280/wetted channel width; (i.e. pool spacing= #channel widths per pool.). Also, pools have good cover and cool water[4] and only minor reduction of pool volume by fine sediment. **Steelhead/Chinook**: Channel width (ft) # pools/mile[17] 5 feet 184 10 feet 96 15 feet 70 20 feet 56 25 feet 47 50 feet 26		AQ-7 see above

	75 feet 23 100 feet 18 Also meets pool frequency standards and large woody debris recruitment standards for properly functioning habitat		
	Large Pools/Pool Quality **Bull Trout**: Each reach has many large pools > than 1 meter deep. **Steelhead/Chinook**: pools >1 meter deep (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment.		AQ-7 see above
	Off-channel Habitat **Bull Trout**: Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; side- channels are low energy areas.[4] **Steelhead/Chinook**: backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.) [4]		AQ-3 see above
	Refugia **Bull Trout**: Habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species.[12,13] **Steelhead/Chinook**: Habitat refugia exist and are adequately buffered (e.g. by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[12]		AQ-3 see above WF-2 see above WF-3 see above
Channel Conditions and Dynamics			

Width/Depth Ratio <10, mean wetted width divided by mean depth	**Average Wetted Width/Maximum Depth Ratio in scour pools in a stream reach.** **Bull Trout**: < or equal to 10[7,5] **Steelhead/Chinook**: <10 [7,9]	**Aquatic Habitat** 3. Channel Shape and Function	SC-3 Channel morphology, structure, complexity, and diversity are in ranges that are characteristic of the local geology, climate, and geologic processes.
Bank Stability >80% stable	**Streambank Condition** **Bull Trout**: >80% of any stream reach has > or equal to 90% stability.[5] **Steelhead/Chinook**: >90% stable; i.e., on average less than 10% of banks are actively eroding[7]		SC-2 The physical integrity of the aquatic system, including shorelines, banks, and bottom configurations, are properly functioning and in dynamic equilibrium with the flow and sediment regimes under which aquatic systems have evolved.
	Floodplain Connectivity **Bull Trout/Steelhead/Chinook**: Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	**Aquatic Habitat** 3. Channel Shape and Function	SC-4 Channel-floodplain connections are intact. Channel bed and bank erosion rates are within natural ranges and do not result in degraded aquatic or riparian habitats or channel alteration.
Flow/Hydrology			
	Change in Peak/Base Flows **Bull Trout/Steelhead/Chinook**: Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography.	**Water Quantity** 1. Flow Characteristics	HF-1 Flow regimes, including water yield, timing, frequency, magnitude, and duration of runoff, are sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of movement of sediment, nutrients, and wood. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows are within the natural range of variability in which the system developed.
	Change in Drainage Network **Bull Trout**: Zero or minimum increases in active channel length correlated with human caused disturbance. **Steelhead/Chinook**: zero or minimum increases in drainage network density due to roads[18,19]		HF-1 see above
Watershed Conditions			

	Road Density/Location **Bull Trout**: <1 miles per square mile, no valley bottom roads[13] **Steelhead/Chinook**: <2 miles per square mile, no valley bottom roads [20]	**Roads & Trails** 1. Open Road Density 2. Road Maintenance 3. Proximity to Water	KWS-2 Roads in key watersheds present minimal risk to aquatic resources.
	Disturbance History **Bull Trout/Steelhead/Chinook**: <15% Equivalent Clear-cut Area (ECA) of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area. [14]	**Roads & Trails** 2. Road Maintenance 3. Proximity to Water 4. Mass Wasting **Fire Regime or Wildfire** 1. Fire Condition Class or 2. Wildfire Effects **Forest Cover** 1. Loss of Forest Cover	SS-1 The distribution and abundance of forested structural stages creates conditions that are ecologically resilient sustainable and compatible with natural levels of disturbance processes. Table 3 displays the range of conditions representing the desired proportion of each upland forest potential vegetation group existing in each of the forested structural stages. The range of desired conditions reflects the natural variations in the mix of structural stage combinations that would be expected to occur across the landscape over time and also allows for flexibility with regards to addressing other desired conditions. DP-1 Fire adapted and fire resilient landscapes are restored and maintained. Wildland fire (planned and unplanned ignitions) plays a characteristic ecological role in creating forest and rangeland conditions that are resilient to disturbances and climate changes. Table 2 displays the natural fire regimes and their associated desired condition ranges for fire severity and frequency by potential vegetation group. Wildland fire may be suitable on all acres, depending on expected fire effects and resource objectives. DP-2 In landscapes that are currently in FRCC 2 or 3, or exhibit a moderate or high vegetation departure score, the FRCC or departure score is decreased to FRCC 1 or a low-level departure score. In landscapes that are currently in FRCC 1 or are exhibiting a low vegetation departure score, these conditions are maintained over time. Wildland fire disturbances and their associated effects

			occur within natural fire regimes similar to those that occurred prior to the modern fire exclusion (suppression) era. Composition and structure of vegetation and fuels characteristics are similar to the conditions that existed under the historical fire regime.
	Riparian Management Areas **Bull Trout/Steelhead/Chinook**: Riparian management areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community /composition >50%. [15]	**Riparian/Wetland Vegetation** 1. Vegetation Condition	WF-1 The watershed-scale processes that control the routing of water, sediment, wood, and organic material operate at levels that support native aquatic species and the proper function of their habitat and do not require human intervention or restoration. RMA-1 Riparian management areas (RMAs) within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical, and biological conditions appropriate to natural disturbance regimes affecting the area. RMA-4 Riparian vegetation has the species composition, structural diversity, age class diversity, and extent that is characteristic of the setting in which it occurs and the hydrologic and disturbance regimes in which it developed. The condition and composition of small habitat patches may change over small temporal and spatial scales but remains relatively constant at larger scales. Plant communities are similar in species composition, age class structure, canopy density, and ground cover to plant associations (Crowe and Clausnitzer 1997) that are representative of a particular setting.
	Disturbance Regime **Bull Trout**: Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life history forms. [1] Natural processes are stable. **Steelhead/Chinook**: no indicator	**Fire Regime or Wildfire** 1. Fire Condition Class or 2. Wildfire Effects **Forest Cover** 1. Loss of Forest Cover	WF-1 see above WF-2 see above WF-3 see above DP-1 see above
	Integration of Pathways		WF-1 see above WF-2 see above

	Bull Trout: Habitat quality and connectivity among subpopulations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years.) The subpopulation is fluctuating around equilibrium or is growing. [1] **Steelhead/Chinook**: no indicator		WF-3 see above

Blue Mountain LMP Abbreviations for Desired Condition labels are: Watershed Function (WF), Riparian Management Area/Riparian Function (RF), Stream Channel (SC), Aquatic Habitat (AQ), Species Diversity (SD), Structural Stage (SS), Federally Listed Species (FLS), Water Quality (WQ), Water Uses (WU), Key Watersheds (KWS), Forest Vegetation (VEG) and Disturbance Processes (DP)

Land Management Plan Direction

Guidance in this Appendix is specifically tied to standards WM-1S and RMA-1S, and guideline GM-3G within the revised plan. Making this tie to key management direction is consistent with the INFISH, PACFISH, and the 2014 updated Interior Columbia Basin Strategy that states, "Plans should provide direction to assure that projects balance short-term risks and long-term benefits to aquatic and riparian resources in managing toward desired conditions." Standards and guidelines, along with other components of the LMP, are intended to collectively improve aquatic and riparian functions and processes over the life of the plan. For example, an action that proposes to revise an allotment management plan would need to comply with all applicable Forest-wide standards and guidelines. To comply with standard WM-1S the action would need to ensure baselines within desired conditions are maintained before the action could proceed. If the baseline were outside desired conditions then the action would need to restore or not retard attainment of desired conditions before it could proceed. To assist in determining consistency with this standard, the land manager would use MPI and/or WCF indicators in this Appendix.

Not every project, even in a degraded baseline, will be restorative. Some management actions will be proposed in a watershed with a "functioning at unacceptable risk" (impaired function according to the WCF) baseline that will result in short-term "degrade" determination. These management actions are appropriate as long as they do not retard the attainment of aquatic and riparian desired conditions. If riparian and watershed processes are to be restored over time within watersheds that have impaired baselines, it is critical that management actions individually and collectively do not further degrade or retard attainment of desired conditions, as evaluated using WCIs. It is also critical that management actions in ARCS Priority Subwatersheds provide some degree of restoration to WCIs (WCF indicators) at the appropriate temporal and spatial scales if desired conditions are to be achieved. For example, if after ten years management actions in an ARCS Priority Subwatershed have only maintained impaired conditions, then restoration would not be realized, nor the intent of the long-term ARCS.

Matrix of Pathways and Indicators

Pathways and WCF Criteria

The eight pathways described in Table 2 represent a suite of ecological indicators identified as WCIs. The ecological indicators values, or WCIs, found in the MPI are diagnostic tools to assist in comparing and evaluating current soil, water, riparian, and aquatic watershed conditions. The habitat indicators correspond to the physical and biological features (PBFs), formerly known as essential features or primary constituent elements, of designated critical habitat for steelhead and bull trout.

Units of measure specific to each WCI are provided, followed by functionality definitions for each WCI that are represented as ranges within their respective units of measurement. There are three functional condition levels identified for each WCI: (1) "functioning appropriately," (2) "functioning at risk," and (3) "not properly functioning"

The quantitative and qualitative default WCI values provided are not intended to be standards nor absolute values that precisely define desired conditions. Instead, the values and descriptions comprise a diagnostic tool to promote discussions and evaluations of the environmental functional relationships specific to the watershed being considered for management actions. WCIs are criteria to assist in evaluating progress towards an attainment of soil, water, riparian, and aquatic goals. They do not replace state and federal water quality standards under the Clean Water Act or state laws, nor do they make determination of effects to listed fish from proposed management actions considered through the section 7 consultation process.

It is critical that WCIs be refined, as needed, to better reflect conditions that are functionally attainable in a specific area based on the geoclimatic setting which includes local geology, land and channel form, climate, potential vegetation, historic and recoverable fish habitat. If default WCI values are not functionally attainable given the inherent characteristics of the watershed being considered or if better local data are available to help define a more site- or watershed-specific WCI value, follow procedures in the "Indicator Adaptation" section in this Appendix to document the basis for the change. If local data relating to a specific WCI are not available for comparison and verification, then appropriate default WCI values can be used.

The suite of relevant WCIs, considered together, encompasses the environmental baseline or current condition for the analysis area (e.g., subwatershed) and associated aquatic resources. The user must realize not every indicator may be relevant to every area assessed. For example, indicators specific to only bull trout subpopulation characteristics (e.g., life history, genetic characteristics, etc.) would not be completed if bull trout were absent (e.g. currently or historically) in the assessment area. In these situations a "not applicable" should be recorded under the desired and existing condition columns.

Table 2 - Matrix of Pathways and Indicators

Diagnostic or Pathway	Functioning Appropriately	Functioning at Risk	Not Properly Functioning
Species Population characteristics: **Bull trout only: subpopulation characteristics within subpopulation watersheds (occupied habitat only)** **Steelhead/Chinook only: MSA population characteristics**			
Subpopulation size	**Bull Trout**: Mean total subpopulation size or local habitat capacity more than several thousand individuals. All life stages evenly represented in the subpopulation.[1] **Steelhead/Chinook**: no indicator	**Bull Trout**: Adults in subpopulation are less than 500 but greater than 50.[1] **Steelhead/Chinook**: no indicator	**Bull Trout**: Adults in subpopulation has less than 50.[1] **Steelhead/Chinook**: no indicator
Growth and Survival	**Bull Trout**: Subpopulation has the resilience to recover from short-term disturbances (e.g. catastrophic events, etc.) or subpopulation declines within one to two generations (5 to 10 years)[1]. The subpopulation is characterized as increasing or stable. At least 10 plus years of data support this estimate.[2] **Steelhead/Chinook**: no indicator	**Bull Trout**: When disturbed, the subpopulation will not recover to pre-disturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend[1]. At lead 10 plus years of data support this characterization. [2] If less data is available and a trend cannot be confirmed a subpopulation will be considered at risk until enough data is available to accurately determine its trend. **Steelhead/Chinook**: no indicator	**Bull Trout**: The subpopulation is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the subpopulation condition will not improve within two generations (5 to 10 years.)[1] This is supported by a minimum of 5 plus years of data. **Steelhead/Chinook**: no indicator
Life History Diversity and Isolation	**Bull Trout**: The migratory form is present and the subpopulation exists in close proximity to other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring subpopulations are large with high likelihood of producing surplus	**Bull Trout**: The migratory form is present but the subpopulation is not close to other subpopulations or habitat disruption has produced a strong correlation among subpopulations that do exist in proximity to each other. [1] **Steelhead/Chinook**: no indicator	**Bull Trout**: The migratory form is absent and the subpopulation is isolated to the local stream or a small watershed not likely to support more than 2,000 fish. [1] **Steelhead/Chinook**: no indicator

Diagnostic or Pathway	Functioning Appropriately	Functioning at Risk	Not Properly Functioning
	individuals or straying adults that will mix with other subpopulation groups. [1] **Steelhead/Chinook**: no indicator		
Persistence and Genetic Integrity	**Bull Trout**: Connectivity is high among multiple (5 or more) subpopulations with at least several thousand fish each. Each of the relevant subpopulations has a low risk of extinction. [1] The probability of hybridization or displacement by competitive species is low to nonexistent. **Steelhead/Chinook**: no indicator	**Bull Trout**: Connectivity among multiple subpopulations does occur, but habitats are more fragmented. Only one or two of the subpopulations represent most of the fish production. [1] The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred. **Steelhead/Chinook**: no indicator	**Bull Trout**: Little or no connectivity remains for refounding subpopulations in low numbers, in decline, or nearing extinction. Only a single subpopulation or several local populations that are very small or that otherwise are at high risk remain. [1] Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred. **Steelhead/Chinook**: no indicator
<u>HABITAT</u>			
<u>Water Quality:</u>			
Temperature	**Bull Trout**: 7 day average maximum temperature in a reach during the following life history stages: [1,3] Incubation 2 - 5° C Rearing 4 - 12° C Spawning 4 - 9° C Also temperatures do not exceed 15° C in areas used by adults during migration (no thermal barriers).	**Bull Trout**: 7 day average maximum temperature in a reach during the following life history stages: [1,3] Incubation < 2° C or 6° C Rearing < 4° C or 13 - 15° C Spawning < 4° C or 10° C Also temperatures in areas used by adults during migration sometimes exceed 15 ° C. **Steelhead/Chinook**: 57-60° F (spawning)	**Bull Trout**: 7 day average maximum temperature in a reach during the following life history stages: [1,3] Incubation < 1° C or > 6° C Rearing > 15° C Spawning < 4° C or > 10° C Also temperatures in areas used by adults during migration regularly exceed 15° C (thermal barriers present).

Diagnostic or Pathway	Functioning Appropriately	Functioning at Risk	Not Properly Functioning
	Steelhead/Chinook: 50-57° F[16]	57-64° F (migration & rearing)[7]	**Steelhead/Chinook**: > 60° F (spawning) > 64° F (migration & rearing) [7]
Sediment (in areas of spawning and incubation; rearing areas will be addressed under the indicator "**Substrate Embeddedness"**	**Bull Trout**: Similar to chinook salmon[1]: for example:(e.g.,): < 12% fines (< 0.85 mm) in gravel; [4] (< 20% surface fines of < 6 mm. [5,6] **Steelhead/Chinook**: <12% fines (<0.85mm) in gravel [4], turbidity low	**Bull Trout**: Similar to chinook salmon[1]: e.g. < 12-17% fines (< 0.85 mm) in gravel[4]; (e.g.) 2-20% surface fines. [7] **Steelhead/Chinook**: <12-20% fines, turbidity moderate [7]	**Bull Trout**: Similar to chinook salmon[1] e.g. >17% fines (< 0.85 mm) in gravel; [4] e.g. >20% fines at surface or depth in spawning habitat.[7] **Steelhead/Chinook**: >20% fines at surface or depth in spawning habitat, turbidity high
Chemical Contamination/ Nutrients	**Bull Trout/Steelhead/Chinook**: Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no Clean Water Act 303(d) designated reaches. [8]	**Bull Trout/Steelhead/Chinook**: Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one Clean Water Act 303(d) designated reach. [8]	**Bull Trout/Steelhead/Chinook**: High levels of chemical contamination from agricultural, industrial and other sources, high excess nutrients, more than one Clean Water Act 303(d) designated reaches. [8]

Habitat Access:			
Physical Barriers	**Bull Trout/Steelhead/Chinook**: Man-made barriers present in watershed allow upstream and downstream fish passage at all flows.	**Bull Trout/Steelhead/Chinook**: Man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows.	**Bull Trout/Steelhead/Chinook**: Man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.
Habitat Elements:			
Bull trout: Substrate Embeddedness in rearing areas (spawning and incubation areas were addressed under the indicator "**Sediment"** **Steelhead/Chinook:** Substrate (fine sediment was addressed under the indicator "**Sediment/ Turbidity")**	**Bull Trout**: Reach embeddedness <20% [9,10] **Steelhead/Chinook**: dominant substrate is gravel or cobble (interstitial spaces clear) or embeddedness <20%[4]	**Bull Trout**: Reach embeddedness 20-30% [9,10] **Steelhead/Chinook**: gravel or cobble is subdominant, or if dominant, embeddedness 20-30%[4]	**Bull Trout**: Reach embeddedness >30% [9,10] **Steelhead/Chinook**: bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[7]
Large Woody Debris	**Bull Trout**: Current Eastside values are being maintained at >20 pieces/mile >12 inches diameter >35 feet length; [11,] also adequate sources of woody debris available for both long and short term recruitment. **Steelhead/Chinook**: >20 pieces/mile >12 inches diameter > 35 feet length; [7] and adequate sources of woody debris recruitment in riparian areas	**Bull Trout**: Current Eastside levels are being maintained at minimum levels desired for "functioning appropriately",[11] but potential sources for long term woody debris recruitment is lacking to maintain these minimum values. **Steelhead/Chinook**: Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard.	**Bull Trout**: Current Eastside levels are not at those desired values for "functioning appropriately", [11] and potential sources of woody debris for short and/or long term recruitment are lacking. **Steelhead/Chinook**: Does not meet standards for properly functioning and lacks potential large woody debris recruitment.
Pool Frequency and Quality	**Bull Trout**: Pool frequency in a reach closely approximates:	**Bull Trout**: Pool frequency is similar to values in "functioning appropriately", but	**Bull Trout**: Pool frequency is considerably lower than values desired for "functioning

	Wetted width (ft) # pools/mile 0-5 feet 39 5-10 feet 60 10-15 feet 48 15- 20 feet 39 20-30 feet 23 30-35 feet 18 35-40 feet 10 40-65 feet 9 65-100 feet 4 (Can also use formula: pools/mi= 5280/wetted channel width; (i.e., pool spacing= #channel widths per pool.) Also, pools have good cover and cool water[4] and only minor reduction of pool volume by fine sediment. **Steelhead/Chinook**: Channel width (ft) # pools/mile[17] 5 feet 184 10 feet 96 15 feet 70 20 feet 56 25 feet 47	pools have inadequate cover/ temperature, [4]and/or there has been a moderate reduction of pool volume by fine sediment. **Steelhead/Chinook**: meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	appropriately"; also cover/temperature is inadequate, [4] and there has been a major reduction of pool volume by fine sediment. **Steelhead/Chinook**: does not meet pool frequency standards

	50 feet 26 75 feet 23 100 feet 18 Also meets pool frequency standards and large woody debris recruitment standards for properly functioning habitat		
<u>Bull trout:</u> <u>Large Pools</u> (adult holding, juvenile rearing, and overwintering reaches where streams are >3m in wetted width at baseflow) **<u>Steelhead/Chinook</u>:** <u>Pool Quality</u>	**Bull Trout**: Each reach has many large pools > than 1 meter deep. **Steelhead/Chinook**: pools >1 meter deep (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment.	**Bull Trout**: Reaches have few large pools (>1 meter) present. **Steelhead/Chinook**: few deeper pools (> 1 meter) present or inadequate cover/temperature, moderate reduction of pool volume by fine sediment	**Bull Trout**: Reaches have no deep pool (>1 meter). **Steelhead/Chinook**: no deep pools (> 1 meter) and inadequate cover/ temperature, major reduction of pool volume by fine sediment
Off-channel Habitat	**Bull Trout**: Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; side-channels are low energy areas.[4] **Steelhead/Chinook**: backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.) [4]	**Bull Trout**: Watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side- channels are generally high-energy areas.[4] **Steelhead/Chinook**: some backwaters and high energy side channels[4]	**Bull Trout**: Watershed has few or no ponds, oxbows, backwaters, or other off-channel areas.[4] **Steelhead/Chinook**: few or no backwaters, no off-channel ponds[4]

Refugia: **bull trout:** see checklist footnotes for definition of this indicator/ **Steelhead/Chinook:** Important remnant habitat for sensitive aquatic species	**Bull Trout**: Habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species.[12,13] **Steelhead/Chinook**: Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[12]	**Bull Trout**: Habitats capable of supporting strong and significant populations are insufficient in size, number and connectivity to maintain all life stages and forms of the species. [12,13] **Steelhead/Chinook**: Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[12]	**Bull Trout/Steelhead/Chinook**: Adequate habitat refugia do not exist.[12]
Channel Condition & Dynamics:			
Bull trout: Average Wetted Width/Maximum Depth Ratio in scour pools in a reach **Steelhead/ Chinook:** Width/Depth ratio	**Bull Trout**: < or equal to 10[7,5] **Steelhead/Chinook**: <10 [7,9]	**Bull Trout**: 11-20[5] **Steelhead/Chinook**: 10-12 (NMFS unaware of any criteria to reference)	**Bull Trout**: >20[5] **Steelhead/Chinook**: >12 (NMFS unaware of any criteria to reference)
Streambank Condition	**Bull Trout**: >80% of any stream reach has > or equal to 90% stability.[5] **Steelhead/Chinook**: >90% stable; i.e., on average less than 10% of banks are actively eroding[7]	**Bull Trout**: 50-80% of any stream reach has > or equal to 90% stability. [5] **Steelhead/Chinook**: 80-90% stable[7]	**Bull Trout**: <50% of any stream reach has > or equal to 90% stability. [5] **Steelhead/Chinook**: <80% stable[7]
Floodplain Connectivity	**Bull Trout/Steelhead/Chinook**: Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	**Bull Trout/Steelhead/Chinook**: Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation and succession.	**Bull Trout/Steelhead/Chinook**: Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent is drastically reduced and riparian vegetation and succession is altered significantly.

Flow/Hydrology:			
Change in Peak/Base Flows	**Bull Trout/Steelhead/Chinook**: Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography.	**Bull Trout/Steelhead/Chinook**: Some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography.	**Bull Trout/Steelhead/Chinook**: Pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography.
Increase in Drainage Network	**Bull Trout**: Zero or minimum increases in active channel length correlated with human caused disturbance. **Steelhead/Chinook**: zero or minimum increases in drainage network density due to roads[18,19]	**Bull Trout**: Zero or minimum increases in active channel length correlated with human caused disturbance. **Steelhead/Chinook**: moderate increases in drainage network density due to roads (e.g., ~5%)[18,19]	**Bull Trout**: Greater than moderate increases in active channel length correlated with human caused disturbance. **Steelhead/Chinook**: significant increases in drainage network density due to roads (e.g., ~20-25%)[18,19]
Watershed Conditions:			
Road Density and Location	**Bull Trout**: <1 miles per square mile, no valley bottom roads[13] **Steelhead/Chinook**: <2 miles per square mile, no valley bottom roads [20]	**Bull Trout**: 1-2.4 miles per square mile, some valley bottom roads[13] **Steelhead/Chinook**: 2-3 miles per square mile, some valley bottom roads [7]	**Bull Trout**: > 2.4 miles per square mile, many valley bottom roads.[13] **Steelhead/Chinook**: >3 miles per square mile, many valley bottom roads[7]
Disturbance History	**Bull Trout/Steelhead/Chinook**: <15% Equivalent Clear-cut Area (ECA) of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area. [14]	**Bull Trout/Steelhead/Chinook**: <15% ECA of entire watershed but disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area. [14]	**Bull Trout/Steelhead/Chinook**: >15% ECA of entire watershed and disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area. [14]
Riparian Management Areas	**Bull Trout/Steelhead/Chinook**: Riparian management areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species	**Bull Trout/Steelhead/Chinook**: Moderate loss of connectivity or function (shade, large woody debris recruitment, etc.) of riparian management areas, or incomplete protection of habitats and refugia for sensitive aquatic species (70-80% intact), and adequately buffer impacts on	**Bull Trout/Steelhead/Chinook**: Riparian management areas are fragmented, poorly connected, or provide inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands:

	(>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community /composition >50%. [15]	rangelands: percent similarity of riparian vegetation to the potential natural community/ composition 25-50% or better. [15]	percent similarity of riparian vegetation to the potential natural community/ composition <25%. [15]
Disturbance Regime **(bull trout only)**	**Bull Trout**: Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life history forms. [1] Natural processes are stable. **Steelhead/Chinook**: no indicator	**Bull Trout**: Scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate. **Steelhead/Chinook**: no indicator	**Bull Trout**: Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. [1] Natural processes are unstable. **Steelhead/Chinook**: no indicator
<u>Species and Habitat:</u>			
Integration of Species and Habitat Conditions (**bull trout only)**	**Bull Trout**: Habitat quality and connectivity among subpopulations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years.) The subpopulation is fluctuating around equilibrium or is growing. [1] **Steelhead/Chinook**: no indicator	**Bull Trout**: Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to pre-disturbance conditions within one generation (5 years.) Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend. Connectivity among subpopulations occurs but habitats are more fragmented. [1] **Steelhead/Chinook**: no indicator	**Bull Trout**: Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will not improve within two generations (5 to 10 years.) Little or no connectivity remains among subpopulations. The subpopulation survival and recruitment responds sharply to normal environmental events. [1] **Steelhead/Chinook**: no indicator

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[2] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus)* populations. Conservation Biology 11(4): 1015-1018.

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[4] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

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[7] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.

[8] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.

[9] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.

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[12] Frissell, C.A., Liss, W.J., and David Bayles. 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[13] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405.

[14] Northwest Forest Plan. 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[15] Winward, A.H. 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p277.

[16] Bjornn, T.C. and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.

[17] USDA Forest Service. 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

[18] Wemple, B.C. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

[19] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

[20] USDA Forest Service. 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

Matrix "Environmental Baseline"

The environmental baseline section of the matrix in Table 3 is similar to "Step 3: Description of Current Conditions" section for soil, water, riparian and aquatic resources described in *Version 2.2 of the Federal Guide for Ecosystem Analysis at the Watershed Scale* (1995). Completion of this part of the matrix provides the supporting documentation and rationale for the evaluations and determinations of the environmental baseline condition included in a watershed or project-specific NEPA analysis. The Matrix was intended to characterize environmental baselines at the watershed scale (i.e. 5th field hydrologic unit {HU}). However, baselines can be assessed at multiple spatial scales (e.g., 4th to 7th field hydrologic units [HUs]); with caution that at very fine scales some indicators (e.g. disturbance history) may not be applicable. When evaluating the baseline condition, all land ownerships should be included at the relevant spatial scale for which the Matrix is completed.

The current condition of each WCI is represented as falling within its respective functionality class as described in Table 2, including any refinements to the default values with a footnote listing what process was used to modify them. Thus, this evaluation documents whether an analysis area (e.g., subwatershed) is "functioning appropriately", "functioning at risk" or "functioning at unacceptable risk" with respect to the conditions evaluated by a particular WCI. The units of measure for WCIs are generally reported in one of two ways: (1) quantitative metrics that have associated numeric values (for example, "large woody debris: > 20 pieces per mile"); or (2) qualitative descriptions based on field reviews, professional judgment, etc. (e.g., "physical barriers: man-made barriers present"). Different approaches are needed because numeric data are not always readily available for every WCI, or there are no reliable numeric values. In such cases, a qualitative description of overall functionality may be the only appropriate method to describe the value. When documenting the baseline condition in the Matrix the rationale for that condition must be supported with a narrative description in the project analysis.

Ideally, the baseline condition determination is based on field measurements (habitat inventories, the status and trend of stream habitat and riparian areas from Pacfish-Infish Biological Opinion (PIBO) Monitoring Program data, etc.), but if data are not available another form of measurement and/or professional judgment must be applied. Those projects that have a greater chance of causing adverse effects in areas with no to little baseline information should conduct the appropriate level of field surveys to support the decision. The level of information collected should be commensurate with the scope and scale of project being proposed.

The suite of relevant WCIs, considered together, encompasses the environmental baseline for the relevant spatial scale and associated aquatic resources. The user must realize not every indicator may be relevant to every area assessed. For example, indicators specific to only bull trout subpopulation characteristics (e.g., life history, genetic characteristics, etc.) would not be completed if bull trout were currently or historically absent in the assessment area. In these situations a "not applicable" should be recorded under the desired and existing condition columns.

Matrix "Effects of the Management Action"

The Matrix provides a synthesis of the collective effects of a proposed or ongoing action(s) on watershed and aquatic habitat conditions and processes, as measured by WCIs. This evaluation will assist the land manager in determining compliance with important LMP standards and guidelines, and if water and aquatic resources will be sustained.

The effects of management actions described in Table 3 are represented as a change in the functionality of the conditions and processes evaluated by the WCI(s) that would likely result from proposed or ongoing management actions. Effects are identified on the basis of the amount of restoration or degradation for each WCI. Table 3 is designed to be used in conjunction with reference conditions (Table 2) and environmental baseline conditions. Together they document the effects on watershed and aquatic habitat conditions and processes in terms of being "restored", "maintained", "degraded", or "not applicable". As with baseline conditions, each action impact in the Matrix must be supported with a quantitative and/or narrative description in the project analysis.

The suite of WCIs must be considered together, both those affected by a proposed action and those not affected, in order to fully describe the condition and trend of the subwatershed and associated aquatic resources and designated beneficial uses that would result from implementation of a proposed management action or continuation of ongoing actions. Table 3 provides supporting documentation for the evaluations and determinations of effects included in biological assessments and/or project-specific National Environmental Policy Act (NEPA) analyses.

Table 3 - Baseline and Project Effects Matrix

Diagnostic or Pathway	Properly Functioning/ Functioning Appropriately	Functioning At Risk	Not Properly Functioning/ Functioning At Unacceptable Risk	Project Effects		
Bull Trout Subpopulation Characteristics w/in Subpopulation Watersheds:				**Restore**	**Maintain**	**Degrade**
Subpopulation Size						
Growth & Survival						
Life History Diversity & Isolation						
Persistence & Genetic Integrity						
Water Quality:						
Temperature						

Sediment/Turbidity Substrate Embeddedness						
Chem. Contamination Nutrients						
Habitat Access:						
Physical Barriers						
Habitat Elements:						
Large Woody Material						
Pool Frequency						
Pool Quality/Large Pools						
Off-channel Habitat						
Refugia						
Channel Condition and Dynamics:						
Width/Depth Ratio						
Streambank Condition						
Floodplain Connectivity						
Watershed Conditions:						
Road Density/Location Drainage						
Disturbance History Peak Base Flows						
Riparian Habitat Conservation Areas						
Disturbance Regime						
*Integration of Species and Habitat Conditions						

Local Modification of Matrix Indicators

Previous Modifications for Pool Frequency Standard (applied by Umatilla National Forest)

The research conducted for the Interior Columbia Basin Ecosystem Management Project (ICBEMP) was used to determine whether or not a stream or reach is functioning appropriately or functioning at risk. Summaries from this research were described by Shaun McKinney, et al. (1996) in Aqua-Talk R-6 Fish Habitat Relationship Technical Bulletin Number 11 "*A Characterization of Inventoried Streams in the Columbia River Basin*." A stream or reach would be considered functioning appropriately if it was equal to or greater than the median value of unmanaged streams in the Blue Mountain Province based on McKinney et al. (1996) summary.

The median pools per channel width in unmanaged streams in the Blue Mountain Province were 0.028. This value was compared to the median value for unmanaged streams in the John Day Basin (which has a much smaller sample size and is a subset of the Blue Mountain Province). The median value for the John Day Basin was 0.027. Due to the larger sample size, the value for the entire Blue Mountain Province was used.

Values for pools per mile are listed below along with standards stated in the February 1998 Draft of "*A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale*" prepared by FWS. Wetted width categories are the same as those presented in the FWS draft paper. The mid-point of the width category was used to calculate the pools per mile using the ICBEMP value. The values listed below are for comparison and the specific standard will be calculated based on the wetted width of each reach.

Wetted Width (ft.)	**ICBEMP (McKinney et al. 1996) pools/mile**	**USFWS pools/mile**
0-5	59*	39
5-10	20	60
10-15	12	48
15-20	8.4	39
20-30	5.9	23
30-35	4.5	18
35-40	3.9	10
40-65	2.8	9
65-100	1.8	4

* For streams less than 5 feet wide, reaches would be expected to have a lower density of pools, there is no available way to calculate an appropriate value, so the standard would defer to the value of 39 pools per mile selected by the USFWS. To calculate the standard pools/mile using the ICBEMP value of 0.028 for specific channel widths use the following formula (all units in parentheses): 5280(ft/mi) x 0.028(pools) / channel width (ft) = standard (pools/mi) or 147.8 / channel width = standard pools/mile

Watershed Condition Framework

As described previously the revised plan will use the WCF process or the MPIs within drainages that do not support listed/proposed fish species. USDA Forest Service WCF (USDA Forest Service 2011) is a comprehensive approach for implementing integrated restoration on priority watersheds on national forests and grasslands. Similar to the MPI, the WCF establishes an approach for classifying watershed condition, using a comprehensive set of 12 indicators (Figure 1 and Table 4) that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. Indicators are grouped according to four major process categories: (1) aquatic physical, (2) aquatic biological, (3) terrestrial physical, and (4) terrestrial biological (Figure 1). These categories represent terrestrial, riparian, and aquatic ecosystem processes or mechanisms by which management actions can affect the condition of watersheds and associated resources.

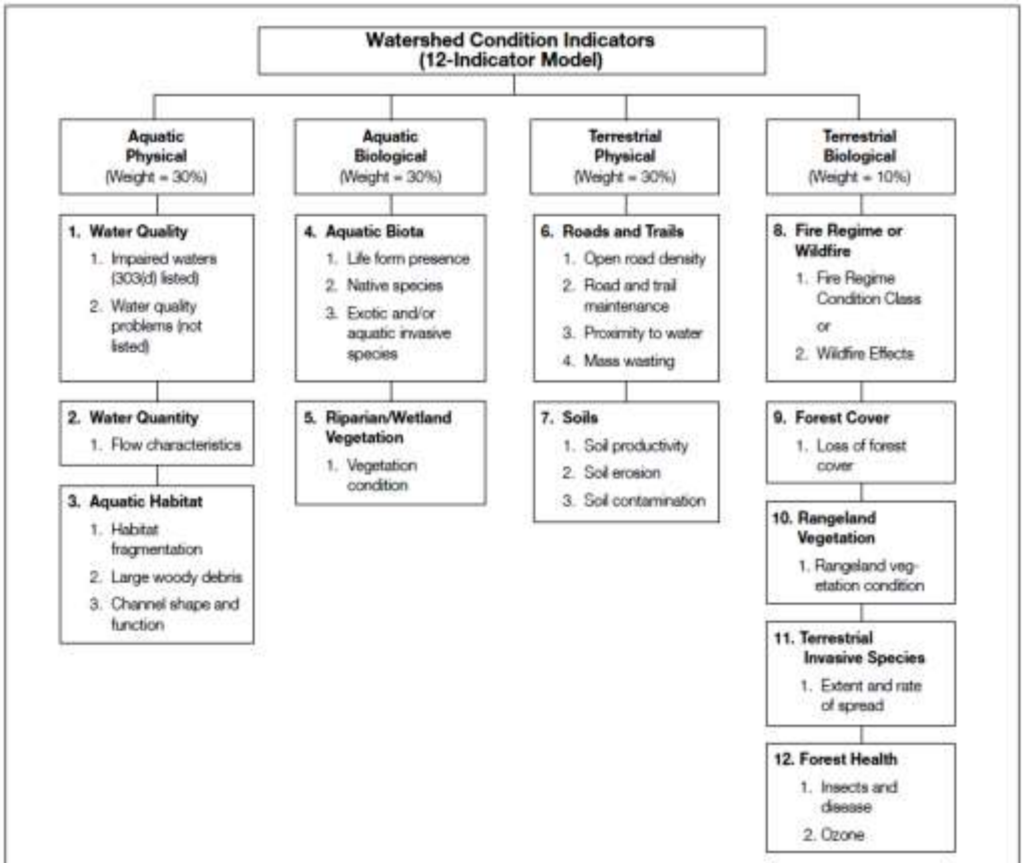

Figure 1 - Core national watershed condition framework indicators.

Each of the four process categories is represented by a set of indicators (Table 4). Each indicator is evaluated using a defined set of attributes. For example, the Aquatic Physical Processes category contains an indicator for Aquatic Habitat Condition. Aquatic habitat condition is evaluated using three attributes: (1) habitat fragmentation, (2) large woody debris, and (3) channel shape and function. Indicators can have as few as one attribute or as many as four attributes. Each indicator attribute receives a condition rating according to criteria in the watershed classification guide25. Similar to the WPI attributes are categorized into one of three conditions “Functioning Properly” “Functioning at Risk” and “Impaired Function”. Ratings are

[25] http://www.fs.fed.us/biology/watershed/condition_framework.html

expressions of the "best-fit" descriptor of the attribute for the entire 6th-level watershed being classified.

Actual on-the-ground conditions in any particular subwatershed may be consistent with or differ from these initial classification results. Therefore, when implementing WM-1S, initial WCF results for a given subwatershed need to be critically evaluated to determine whether they accurately reflect actual conditions and, if not, refined accordingly.

For example, WCF evaluation criteria consider subwatersheds as functioning properly if they have road densities <1 mi/mi^2 (0.625 km/km^2), functioning-at-risk if road densities are >1 mi/ mi2 (0.625 km/ km^2) but less than <2.4 mi/mi^2 (1.5 km/ km^2), and impaired function when road densities are >2.4 mi/ mi2 (1.5 km/km^2). Recently published data from roads on National Forests in Montana (Al- Chokhachy et al. 2016) suggests that these may be reasonable thresholds for coarsely characterizing fine-sediment delivery risks to aquatic habitats associated with surface erosion from road templates. For example, when road densities exceed 1.5 km/km^2, sediment delivery is generally higher and median streambed substrate size finer. Nonetheless, actual road conditions in a particular watershed may differ from the initial road-density based rankings. Recent assessment and monitoring of roads throughout the Pacific Northwest (Luce and Black, unpublished data), for example, indicates that a relatively small portion (1.5-9%) of the road network delivers the majority (90%) of the sediment to streams. If the small portion of roads that cause the majority of problems in a particular subwatershed have been identified and addressed, then for the purposes of applying WM-1S, the subwatershed could be considered to be functioning properly for roads, even if the road densities exceed 1.5k m/km^2. Conversely, a subwatershed could be considered to be functioning-at-risk or impaired function even if road density is <0.625 km/km^2, but the majority of those roads are poorly located, built and/or maintained.

Importantly, roads can adversely affect aquatic habitat in many other ways in addition to delivering fine sediments from surface erosion on the road template. Thus, any refinements of initial road rankings should consider the full suite of applicable impacts and risks that roads pose in a particular subwatershed. These could include aquatic habitat fragmentation, effects on runoff efficiency and peak flows, reductions in shade and large wood delivery, stream-floodplain interactions, invasive species, and poaching. The fine sediment and road density discussion above is intended only to provide an example of how these adjustments could be done for a variety of effects using more refined impact measures than simple road density.

Maintenance and restoration of critical watershed and aquatic habitat conditions and processes are expected to result in diverse and complex habitats capable of providing the combination of habitat features important for the life-history requirements of the fish community in the watershed and supporting other beneficial uses of water associated with aquatic species and watershed function.

Table 4 — Description of the 12 national core watershed condition indicators.

Aquatic Physical Indicators	
1. Water Quality	This indicator addresses the expressed alteration of physical, chemical, and biological components of water quality.

2. Water Quantity	This indicator addresses changes to the natural flow regime with respect to the magnitude, duration, or timing of the natural streamflow hydrograph.
3. Aquatic Habitat	This indicator addresses aquatic habitat condition with respect to habitat fragmentation, large woody debris, and channel shape and function.
Aquatic Biological Indicators	
4. Aquatic Biota	This indicator addresses the distribution, structure, and density of native and introduced aquatic fauna.
5. Riparian/Wetland Vegetation	This indicator addresses the function and condition of riparian vegetation along streams, water bodies, and wetlands.
Terrestrial Physical Indicators	
6. Roads and Trails	This indicator addresses changes to the hydrologic and sediment regimes because of the density, location, distribution, and maintenance of the road and trail network.
7. Soils	This indicator addresses alteration to natural soil condition, including productivity, erosion, and chemical contamination.
Terrestrial Biological Indicators	
8. Fire Regime or Wildfire	This indicator addresses the potential for altered hydrologic and sediment regimes because of departures from historical ranges of variability in vegetation, fuel composition, fire frequency, fire severity, and fire pattern.
9. Forest Cover	This indicator addresses the potential for altered hydrologic and sediment regimes because of the loss of forest cover on forest lands.
10. Rangeland Vegetation	This indicator addresses effects on soil and water because of the vegetative health of rangelands.
11. Terrestrial Invasive Species	This indicator addresses potential effects on soil, vegetation, and water resources because of terrestrial invasive species (including vertebrates, invertebrates, and plants).
12. Forest Health	This indicator addresses forest mortality effects on hydrologic and soil function because of major invasive and native forest insect and disease outbreaks and air pollution.

Examples of project application of MPI and WFC indicators

Example 1 - Thinning and prescribed fire vegetation treatments are proposed over a large area including RMAs to reduce wildfire risks. Current inchannel large woody debris frequency is “Functioning at Risk” based on an evaluation of large woody debris MPI (in areas with listed species and/or critical habitat) or WFC (areas without listed species and/or critical habitat) indicators over most of the analysis area due to past riparian harvest and stream clearing. The proposed activity should be designed in a way that moves ecosystem processes toward desired conditions, leading toward attainment of Functioning Appropriately (MPI)/Functioning Properly (WCF) conditions over the long term, without retarding attainment (e.g., measurably slows the natural rate of recovery) of those desired conditions.

Example 2 - The action is to replace a damaged culvert in a 6th field HU with ESA listed fish with a FR baseline. Currently, surface fines are between 12 and 20%, and embeddedness is between 20 and 30%. This action will cause short-term adverse effects to turbidity and embeddedness indicators downstream, but impacts will not go beyond the 6th field HU. The action will also restore the fish passage indicator, and will maintain all remaining indicators. This action will be appropriate because it does not retard the attainment of riparian processes and functions, and has measurable long-term ecological benefits by restoring fish passage.

Example 3 - A new placer mine, timber sale, and road restoration project on Forest Service administered lands are planned over several 6th field HUs in the same 5th field watershed. The placer mine occurs in a 6th field HU where most indicators are Functioning Appropriately (MPI) or Properly (WCF). The timber sale and road projects occur in HUs where many baseline indicators are Functioning at Risk (MPI) or Poor (WCF). Even though the placer mine will have short- and long-term adverse effects to pool quality and streambank indicators, it is allowed to proceed due to the 1872 mining law. However, the forests works with the permittee to avoid and minimize effects to WCIs functioning appropriately and to not retard attainment of desired conditions where functioning at risk or not properly functioning, to the extent possible within its authorities. The other two projects are designed to restore WCIs in the long term, but will cause degradation in the short term to sediment and peak flows at the 6th field scale.

Cumulative effects (as defined in NEPA) from these actions are expected to occur in a low-gradient reach downstream of each project. If cumulative effects are determined not to degrade or retard indicator functions, the actions can proceed. If cumulative effects degrade indicators at the subwatershed scale, then projects are modified to reduce effects or delayed until baseline conditions improve to be consistent with the Forest Plan.

Indicator Adaptation (How to Modify the MPI and WCF Indicators)

Background

The original matrix values were based on the state of knowledge as of 1995 and used a data set that is less well documented, but consisted of data from stream surveys conducted during the period 1987-1992 located across the Columbia River basin (Chen et al. 1994). Riparian management objectives (RMOs) developed from these surveys have been described as "broad averages" of streams believed to possess good habitat for anadromous fish.

An outcome of implementing PACFISH (USDA FS and USDI BLM 1995) and INFISH (USDA FS 1995), and subsequent Biological Opinions (NMFS 1995, 1998; USFWS 1998) was the establishment of a broad scale monitoring network encompassing the interior Columbia River basin and headwaters of the Missouri River basin that includes more than 200 reference (19 in the Blue Mountains) and well over 500 managed sites, including approximately 300 sites in the Blue Mountains (Kershner et al. 2004; Kershner and Roper 2010). Based on PIBO monitoring results it has become apparent that some of the metrics currently used as RMOs were not attainable for the majority of reference or managed sites (Henderson et al. 2005; Kershner and Roper 2010).

The PIBO monitoring program has provided broad scale information of the status and trend of habitat and riparian conditions (Henderson et al. 2005; Meredith et al. 2013) and more recently has been also used to determine the status and trend of riparian and aquatic habitat conditions for individual forests and hydrologic subbasins (Archer and Meredith 2015a, 2015b, 2015c). The Forest Ecosystem Management Assessment Team (FEMAT) (1993) recognized that "no target or threshold level of (stream) habitat variables can be uniformly applied to all streams" based on the wide range and variability of stream channel characteristics that exists in the Pacific Northwest, and suggested instead that habitat objectives should be developed for individual watersheds.

Existing PIBO monitoring data offers the ability to compare habitat attributes for reference conditions from different biophysical settings across broad areas of the Pacific Northwest and to compare streams with similar physical habitat characteristics. The data and methods exist to describe in more detail what streams are capable of in a given environmental setting as well as describe the range of habitat attributes and conditions that may exist within individual watersheds or subbasins (Buffington et al. 2004).

As described in NMFS (1996) and FWS (1998), there will be circumstances where the numeric values or descriptions in the Matrix simply do not apply to a specific watershed or stream, data are unavailable to support an assessment of existing conditions, and/or those data exist in a different format. The PACFISH (USDA FS and USDI BLM 1995) and INFISH (USDA FS 1995) strategies also recognize this issue. Specifically, those strategies note that the interim RMOs, which are comparable to some of the Matrix indices, do not apply in all situations and need to be refined based on local conditions. Kershner and Roper (2010) affirmed this conclusion, as they found that even in the least disturbed watersheds, none of 726 reference or managed reaches evaluated met all of interim the RMO values.

Habitat standards have often failed as to protect salmon because they are taken as fixed and do not focus on the dynamic process that create and maintain ecologically complex and resilient watersheds (Reeves et al. 1995; Bisson et al. 1997). Further, because channel and habitat attributes vary, the ranges of values of some attributes for different channel types may overlap making it difficult to define categories of functional, functional at risk, or functional at unacceptable risk. This is why it is critical to focus on the ecological functions and processes that must be maintained and restored rather than fixed values that are intended to be general diagnostic indicators of these processes.

Reference Condition Approach

Ideally, when modifying MPIs, functionally attainable indicator values should be based on suitable reference conditions based on the capability of streams in a given biophysical environment. Reference conditions should be as representative as possible of the range of conditions expected in the absence of management (Kershner and Roper 2010). Reference values may be derived from a number of possible sources, including surveys, historical data, and inferences from literature, and local landscape conditions.

Due to their importance and variability, there may be particular interest in modifying the stream channel indicators in the Matrix. The following provides an example of how those indicators may be modified at the broad-scale or project scale. This approach builds upon the recommendations of Kershner and Roper (2010) and Al-Chokhachy et al. (2010), who recommended that habitat objectives should be selected based on: (1) consistently collected data from the area of interest; (2) metrics that show a demonstrated response to management; and (3) methods that account for landscape characteristics that may influence the value of the objective. The approach uses "reference" or minimally-managed watersheds to describe the range of stream habitat and watershed condition attributes that may be expected under natural conditions in a given biophysical environment. These "reference" channel conditions, together with an understanding of key watershed (e.g., mass wasting) and channel (e.g., sediment transport) processes and disturbance histories, can be used to established meaningful management criteria against which the health or condition of particular stream channels in the watershed of interest can be assessed.

It is intended that habitat indicators not be used strictly as standards as this often has diverted attention away from the dynamic processes responsible for the creation and maintenance of ecologically complex and resilient watersheds (Reeves et al. 1995; Bisson et al. 1997). The use of any set of values as standards could result in reduced variability and diversity of habitat conditions rather than promoting the desired diversity and complexity of habitat conditions across large landscapes (ISAB 2003).

Examples

As shown in Table 5, some indicators and/or indicator values in the Matrix may need to be refined and/or perhaps dropped or replaced. For example, pool frequency is currently evaluated based on habitat type and channel width. Specifically, the Matrix indicates that stream channels are 'functioning properly' when pool frequency ranges from 18-184 pools/mile in Steelhead and Chinook habitat and from 4-60 pools/mile in Bull Trout habitat, depending on channel width. As an alternative, evaluators could use data from streams in minimally-managed "reference" watersheds to refine these indicator values. The PIBO "reference" data for the Columbia Basin, for example, indicates that the expected range of pool frequency values varies by channel type. Specifically, it ranges from about 7-160 pools/mile in plane bed channels and from 8-295 pools/mile in Rosgen E channels (Figure 2). An evaluator could, for instance, choose to use the 25th percentile of these distributions as an indicator value for this MPI. In that case, plane bed channels would not be rated as functioning properly if pool frequencies in the channels of interest were less than 20 pools/mile in plane bed channels or 70 pools/mile in Rosgen E channels.

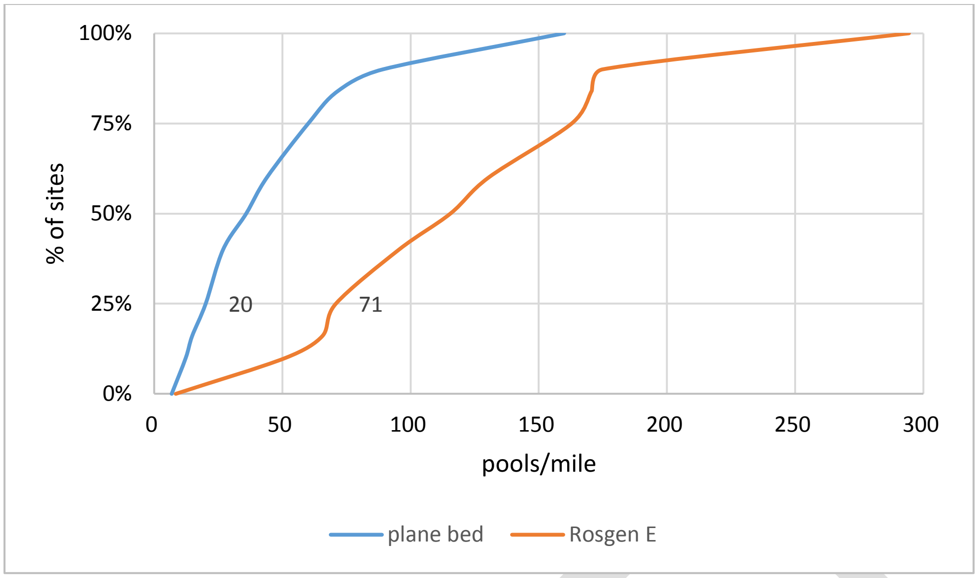

Figure 2. Distribution of pool frequency (pools/mile) values for streams in minimally-managed "reference condition" watersheds of the Columbia River Basin: plane-bed channels, Rosgen E channels. Data are from the Pacfish-Infish Biological Opinion (PIBO) Monitoring Program.

A similar approach could also be used for MPIs, such as sediment/turbidity, where available metrics are similar to, but somewhat different from, those specified in the Matrix. For example, the Matrix uses percent fines (<0.85mm) in gravel and percent surface fines (<6 mm) to assess this indicator. In contrast, PIBO collects data on the median particle size (D_{50}, mm) and pool tail fines (%). Similar to pool frequency, PIBO data for these metrics at reference sites could be analyzed and used to develop specific criteria by which stream channels in a particular area could be evaluated where relevant data exists. The same is true for the streambank condition MPI. In some cases, percent undercut banks and/or bank angle (%) may be more meaningful indicators than streambank stability.

In addition to using data from reference sites, evaluators could also use empirically-derived relationships between channel conditions in reference condition watersheds and various geoclimatic variables. Al-Chokhachy et al. (2010), for example, used data from PIBO reference sites and environment variables to develop regression estimates of eight habitat variables (Table 5). The regression estimates are converted to scores from 0-10 for each metric, then combined to an overall index of habitat condition for each PIBO site scaled from 0 to 100. The habitat index that is currently in use uses only 6 of the original 8 habitat values displayed in Table 5. This method could be used to predict reference values for any reach for which the specified input data is available, allowing a comparison of observed and expected values for any reach of interest.

Table 5 - Empirical (multiple regression) estimates of stream channel metrics in reference watersheds using selected bio-physical variables, Columbia River Basin (Al-Chokhachy et al., 2010).

Percent undercut banks	0.98 - 0.06(grad) - 0.15(precip) - 0.002(area) + 0.08(ign) - 0.18(sed)
Bank angle	58.1 + 6.7(grad) + 14.8(precip) + 0.29(area) + 0.2(segment slope) - 8.9(ign) + 11.7(sed)

D50 (m)	- 5.5 + 0.63(grad) + 0.65(precip) + 0.02(area) - 0.43(drainage den) - 0.32(ign) + 0.0003(elev)
Percent fine sediment (<6 mm)	0.76 - 0.004(area) - 0.11(grad) - 0.19(precip) + 0.12(drainage den) + 0.09(ign)
LWD volume (m3/km)	5.1 + 0.02(% segment forested) - 0.02(segment slope) - 0.001(elev)
LWD frequency (pieces/km)	4.1 + 0.02(% segment forested) - 0.02(segment slope) + 0.48(drainage den)
Residual pool depth (m)	- 1.1 - 0.24(grad) + 0.004(area) + 0.25(precip)
Percent pools	1.6 - 0.2(grad) - 0.003(area) - 0.0001(elev) - 0.20(precip)

Area=catchment area, km^2; precip = average annual precipitation, m; drainage den = the density of streams within the catchment, km/km^2; ign = a categorical variable denoting whether the dominant geology is igneous; grad = reach gradient, %; elev = elevation of the bottom of the reach, m; % segment forested = percentage of the riparian buffer (90 m on each side of stream) that is forested 1 km upstream from the bottom of reach; sed = a categorical variable denoting whether the dominant geology is sedimentary.

Caveats

While this reference condition approach is a viable method for refining MPIs, evaluators should recognize that not all channels are expected to attain these values even in the absence of disturbance. Natural biophysical differences (e.g., geology, precipitation, vegetation) between watersheds results in substantial variability between stream channels so that no single set of indicator values can be applied equally to all streams (Bisson et al. 1997) and attaining these values would not ensure that the processes responsible for habitat formation are functioning or protected (FEMAT 1993). In addition, as noted in Reeves et al (1995), natural stream and aquatic habitat conditions are a function of disturbance such as fires and floods and will exhibit a range of conditions over time. Therefore, not all aquatic habitats are expected to be in a "good" or "desired" condition at all times. Moreover, by definition, if an evaluator uses the 25^{th} percentile as an indicator value, then even 25% of streams in reference condition would not be rated as functioning properly.

Finally, it is critically important that conclusions regarding the status of stream channels be determined based on more than just instream conditions. For example, Lisle et al. (2014) noted that channel conditions can result from multiple pathways and processes, as influenced by both natural conditions and human impacts. They therefore concluded that understanding those pathways and processes is critical to assessing whether channels have been or are being affected by current or past management activities and what, if any, management action is needed. In addition, Montgomery and MacDonald (2002), suggested that in-channel metrics should be used only as one component of a diagnostic procedure for assessing and monitoring stream channel conditions. Specifically they proposed that reach-level channel conditions should be assessed as a function of location in the channel network, regional and local biogeomorphic context, controlling influences such as sediment supply and transport capacity, riparian vegetation, the supply of in-channel flow obstructions, and disturbance history.

Indicator Modification

Given the limitations described above, when a MPI or WCF indicator value is not physically or biologically appropriate, given the inherent characteristics (geoclimatic setting) of the area, the value should be modified. Indicator values should be refined to better reflect conditions that are functionally attainable in a specific watershed or stream reach based on local geology, land and channel form, climate, historic and potentially recoverable fish species habitat, and potential vegetation. Modification of default indicator values may be completed through a variety of methods such as watershed and project analysis. It can be done using results of broad-scale and Forest-wide monitoring and collection and evaluation of watershed and/or stream reach specific data.

It may be appropriate to evaluate habitat and riparian attributes at scales larger than an individual watershed but it should be recognized that watersheds of any size or scale will contain a finite range of channel, habitat, or riparian attributes and that these attributes may vary between watersheds. Because there are a number of ways to modify the default MPIs, each with strengths and weaknesses, the specific methods and data to be used need to be defined and agreed upon by the Forest Service, NMFS, and FWS in watersheds with ESA listed fish and their critical habitat. Regardless of what methods are used, written documentation of the methods and procedures, quality and source of data, and rationale supporting the modifications should be included in record documentation. In watersheds with ESA listed fish and/or critical habitat, modification of MPIs will be coordinated with NOAA Fisheries and/or FWS through Section 7 consultations.

RIPARIAN MANAGEMENT AREAS

As described in the LRMP ARCS, riparian management areas (RMAs) are areas where aquatic and riparian-dependent resources receive primary emphasis and management activities must be designed to benefit those resources. Riparian function and ecological processes descriptions below are intended to:

1. Ensure interdisciplinary teams consider and understand the appropriate riparian ecological processes when planning management actions within or affecting RMAs designed to maintain or improve these processes.
2. Provide additional information to help describe desired conditions. For example, desired condition RMA-1 states: "Riparian management areas within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical, and biological conditions appropriate to natural disturbance regimes affecting the area." The riparian function and ecological processes can help articulate relevant physical (e.g., bank stabilization), chemical (e.g., nutrients), and biological conditions to consider.
3. Provide additional information to help interpret RMA-1S. RMA-1S is intended to maintain riparian areas when at desired conditions and restore/not retard attainment of desired conditions when RMAs are impaired. To fully implement this standard interdisciplinary teams must identify important ecological processes within the analysis area, the status (at desired condition or impaired) of these processes, and evaluate impacts to see how an action maintains, restores, and does not retard attainment of these processes. Descriptions below can help frame the type of processes to consider, the spatial scale they operate, and the important interactions between terrestrial and aquatic ecosystems that need to be considered when defining desired conditions and describing project effects.

Riparian Functions and Ecological Processes: Considerations

Megahan and Hornbeck (2000) state that a properly designed and managed riparian area can provide a variety of amenities, while protecting riparian functions and ecological processes and diversity of species composition. They further state that a properly designed and managed riparian area includes careful management of forests both within, and outside of the riparian area.

Spence et al. (1996) and Quigley and Arbelbide (1997) identify several important considerations when designing management activities within or affecting RMAs. These are as follows:

a) A stream requires predictable and near-natural energy and nutrient inputs.
b) Many plant and animal communities rely on streamside or wetland forests and vegetation for migratory or dispersion habitat.
c) Small streams are generally more affected by hillslope activities than are larger streams.
d) As adjacent slopes become steeper, the likelihood of disturbance resulting in discernable instream effects increases.
e) Riparian vegetation: 1) provides shade to stream channels; 2) contributes large woody debris; 3) adds small organic matter; 4) stabilizes streambanks; 5) controls sediment inputs from surface erosion; 6) and regulates nutrient and pollutant inputs to streams.

Taking a functional approach to delineating an RMA by looking at "zones of influence" (Spence et al. 1996) allows the qualified specialist to focus on specific riparian functions where a relationship between those functions and RMA widths are known. The 'zone of influence' approach provides the qualified specialist a means to distinguish between those riparian functions and ecological processes potentially affected by the proposed actions and those that, regardless of the RMA delineation, the proposed actions will not impair.

In general, the riparian functions and ecological processes that should be considered during project analysis should include (taken primarily from Spence et al. 1996):

- Stream Shading
- Large Woody Debris Recruitment
- Fine Organic Litter
- Bank Stabilization
- Sediment Control
- Nutrients and Other Dissolved Materials
- Riparian Microclimate and Productivity
- Wildlife Habitat
- Windthrow
- Importance of Small Streams
- Importance of Hillslope Steepness

The following are brief discussions on some of the riparian functions and ecological processes that are intended to assist the practitioner in project analysis.

Stream Shading (excerpted from Spence et al. 1996)

The ability of riparian forests to provide shade to stream channels is a function of numerous site-specific factors including vegetation composition, stand height, stand density, latitude (which determines solar angle), topography, stream width, and orientation of the stream channel. These factors influence how much incident solar radiation reaches the forest canopy and what fraction passes through to the water surface. The shading influence of an individual tree can be expressed geometrically as a function of tree height, slope, and solar angle. In natural forests, stand density and composition may moderate the shading influence of trees within this zone, with trees closer to the stream channel and understory shrubs providing the majority of stream shade.

Large Woody Debris Recruitment (excerpted from Spence et al. 1996)

Large wood enters stream channels by a variety of mechanisms, including toppling of dead trees, windthrow, debris avalanches, deep-seated mass soil movements, undercutting of streambanks, and redistribution from upstream. In some systems, wood delivered from upslope areas (via land-sliding) or upstream reaches (via floods or debris torrents) may constitute a significant fraction of the total wood present in a stream reach. When evaluating RMAs, consideration should be given to potential recruitment of wood from upslope areas and non-fish-bearing channel in addition to wood delivered by toppling, windthrow, and bank undercutting.

The potential for a tree or portions of a tree to enter the stream channel by toppling, windthrow, or undercutting is primarily a function of slope distance from the stream channel in relation to tree height and slope angle. Consequently, the zone of influence for large wood recruitment is defined by the particular stand characteristics rather than an absolute distance from the stream channel or floodplain. Other factors, including slope and prevailing wind direction, may influence the proportion of trees that fall in the direction of the stream channel.

Fine Organic Litter (excerpted from Spence et al. 1996)

Smaller pieces of organic litter (leaves, needles, branches, tree tops, and other wood) enter the stream primarily by direct leaf or debris fall, although organic material may also enter the stream channel by overland flow of water, mass soil movements, or shifting of stream channels in unconstrained reaches. Little research has been done relating litter contributions to streams as a function of distance from the stream channel; however, it is assumed that most fine organic litter originates within 30 meters, or 0.5 potential tree heights from the channel.

Bank Stabilization (excerpted from Spence et al. 1996)

Roots of riparian vegetation help to bind soil particles together, making streambanks less susceptible to erosion. In addition, riparian vegetation provides hydraulic roughness elements that dissipate stream energy during high or overbank flows, further reducing bank erosion. In most instances, vegetation immediately adjacent to the stream channel is most important in maintaining bank integrity; however, in wide valleys with shifting stream channels, vegetation throughout the floodplain may be important over longer time periods. Although data quantifying the effective zone of influence relative to root strength is scarce, most of the stabilizing influence of riparian root structure is probably provided by trees within 0.5 potential tree heights of the stream channel. In addition, consideration should be given to the composition of riparian species within the area of influence because of differences in the root morphology of conifers, deciduous trees, and shrubs. Specific relationships between root types and bank stabilization have not been documented; however, if the purpose of riparian protection is to restore natural bank characteristics, then retaining natural species composition is a reasonable target for maintaining bank stabilization function of riparian vegetation.

Sediment Control and Importance of Hillslope Steepness (excerpted from Quigley & Arbelbide 1997)

The ability of RMAs to control sediment input from surface erosion depends on several site characteristics including the presence of vegetation or organic litter, slope steepness and slope roughness, soil type, and drainage characteristics. These factors influence the ability of vegetation to trap sediments by determining the infiltration rate of water and the velocity (and hence the erosive energy) of overland flow. The likelihood of disturbance resulting in discernible instream effects increases as adjacent slopes become steeper. Thus, greater preventive measures to avert negative effects to streams, or restore riparian function and ecological processes on steeper slopes may be required to prevent or reduce instream effects.

Prior research on a variety of wildland and agricultural settings has demonstrated that surface erosion increases with increasing slope steepness, although the increase is not linear. The effect of slope has generally been modeled empirically, and has taken the shape of a power function where the exponent is less than 1, so that slope effects are large for gentle slopes and decline, as slopes get steeper. Megahan and Ketcheson (1996) found that sediment travel distances from road cross drains in the Idaho Batholith are proportional to slope gradient (in percent) raised to the 0.5 power.

Megahan and Ketcheson (1996) present equations for estimating sediment travel distance below road fills (non-channelized flow) and cross drains (channelized flow) that incorporate sediment volume, obstructions, slope angle, and source area as significant explanatory variables. The strongest single variable affecting sediment travel distance from soil disturbing activities is the volume of material displaced, or delivered to a point on a slope from a culvert, drain, etc. Over 78 percent of the variance in sediment travel distance is explained by volume in the culvert model (channelized flow) of Megahan and Ketcheson (1996).

They suggest that, except on steep slopes, RMAs designed to protect other riparian functions will generally control sediments to the degree that they can be controlled by riparian vegetation. It is essential, however, that riparian protection be complemented with practices for minimizing sediment contributions from outside the riparian area, particularly those from roads and associated drainage structures, where large quantities of sediment are often produced. In addition, activities within the RMAs that disturb or compact soils, destroy organic litter, remove large down wood, or otherwise reduce the effectiveness of RMAs as sediment filters should be avoided.

Nutrients and Other Dissolved Materials (excerpted from Spence et al. 1996)

Riparian vegetation takes up nutrients and other dissolved materials as they are transported through the riparian zone by surface or near-surface water movement. However, the relationship between RMA width and filtering capacity is less well understood than other riparian functions and ecological processes. Those studies that have been published indicate substantial variability in the effectiveness of RMAs in controlling nutrient inputs. Identifying an appropriate RMA width that can function as a filter for nutrients and other dissolved materials depends on the specific type and intensity of land use, type of vegetation, quantity of organic litter, infiltration rate of soils, slopes, and other site-specific characteristics.

Because of the variability observed in the effectiveness of RMAs in controlling input of nutrients and other dissolved materials, it is difficult to recommend specific criteria for this function. Spence (1996) suggests that for most forestlands, RMAs designed to protect other riparian functions (e.g., LWD recruitment, shading) are probably adequate for controlling nutrient inputs to the degree that such increases can be controlled by RMAs. Exceptions may occur when fertilizer or other chemical applications result in high concentrations of nutrients in surface runoff.

RMA widths for nutrient and pollution control on rangelands should be tailored to specific site conditions, including slope, degree of soil compaction, vegetation characteristics, and intensity of land use. In many instances, RMA widths designed to protect LWD recruitment and shading may be adequate to prevent excessive nutrient or pollution concentrations. However, where land use activity is especially intense, RMAs for protecting nutrient and pollutant inputs may need to be wider than those designed to protect other riparian functions and ecological processes, particularly when land-use activities may exacerbate existing water quality problems.

Riparian Microclimate and Productivity (excerpted from Spence et al. 1996)

Changes in micro-climatic conditions within the riparian zone resulting from removal of adjacent vegetation can influence a variety of riparian functions and ecological processes that may affect the long-term integrity of riparian ecosystems. However, the relationship between RMA width and riparian microclimate has not been documented in the literature. FEMAT (1993) and Spence (1996) suggest using the generalized curves in FEMAT 1993, relating protection of microclimatic variables relative to distance from stand edges into forests.

Wildlife Habitat (excerpted from Spence et al. 1996)

The importance of riparian areas to many wildlife species is well documented. However, generic recommendations for riparian RMAs to protect wildlife are not justifiable because each species has unique habitat requirements. Some terrestrial and aquatic plant and animal communities rely on the forest and shrubs adjacent to streams and wetlands for all or parts of their life cycles. Animals such as beavers, otters, dippers, and some amphibians are obligate stream and riparian vegetation dependent organisms. Other bird and mammal species and many bat species need the RMAs at crucial life history periods or seasonally for feeding or breeding. Wildlife has a disproportionally high use of riparian areas and streamside forests compared with the overall landscape. RMAs provide habitat needs such as water; cover; food; plant community structure, composition, and diversity; increased humidity; high edge-to-area ratios; and migration routes. When identifying RMAs it is important to also consider the needs of wildlife species.

Windthrow (excerpted from Spence et al. 1996)

Trees within RMAs that are immediately adjacent to clearcuts have a greater tendency to topple during windstorms than trees in undisturbed forests. Extensive blowdown can potentially affect aquatic ecosystems in a number of ways, both positive and negative. In stream systems that lack wood because of past management practices, blowdown may immediately benefit salmonids by providing structure to the channel. Over the long term, however, blowdown of smaller trees may hinder the recruitment of large wood pieces that are key to maintaining channel stability and that provide habitats for vegetation and wildlife within the riparian zone. In addition, soil exposed at the root wads of fallen trees may be transported to the stream channel, increasing sedimentation. Other riparian functions, including shading, bank stabilization, and maintenance of riparian microclimates may also be affected.

Importance of Small Streams

Small streams are more affected by hillslope activities than are larger streams because there are more smaller than larger streams within watersheds (actual area and extent); smaller channels respond more quickly to changes in hydrologic and sediment regimes; and streamside vegetation is a more dominant factor in terms of woody debris inputs and leaf litter and shading. Small perennial and intermittent non-fish-bearing streams are especially important in routing water, sediment, and nutrients to downstream fish habitats.

Channelized flow from intermittent and small streams into fish-bearing streams is a primary source of sediment in mountainous regions. In steep, highly dissected areas, intermittent streams can move large amounts of sediment hundreds of meters, through RMAs, and into fish-bearing streams. In-channel sediment flows are limited primarily by the amount and frequency of flow and by the storage capacity of the channel. Flows in forested, intermittent streams are generally insufficient to move the average-sized wood piece, allowing large wood to accumulate in small channels. These accumulations increase the channel storage capacity and reduce the likelihood of normal flows moving sediment downstream.

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